The Echo of Nature: Sound Technology and the Re-Enchantment of the World

Thomas W. Patteson

To Leopoldo Siano

"Der du die weite Welt umschweifst,
Geschäftiger Geist, wie nah fühl ich mich dir!"
(Goethe, *Faust*)

Introduction

"The poetry of earth is ceasing never…"[1]

A bizarre menagerie of objects is assembled in the concert space—metal sheets and barrels, wooden planks, and plate glass, among other things. Each object is affixed with an audio transducer (essentially a stripped-down loudspeaker) wired to an amplifier. Wave generators, controlled by a handful of different performers, send acoustic signals to the transducers, vibrating the objects to which they are attached. These vibrations, many of them very quiet, are picked up by adjacent contact microphones and are projected through loudspeakers via a central mixing board. Each object is "played" by a wave-generator outputting various signals in order to find the object's unique resonant frequencies, resulting in unpredictable squeals and ululations. The result is a twittering symphony of noises: David Tudor's *Rainforest*, one of the earliest examples of sound installation, the first version of which was performed in 1968.[2]

The question, "But is it *music*?" has been asked of many twentieth-century compositions, but this query has a pointed relevance with regard to *Rainforest*. For not only does this work present us with a sound-world bearing virtually no resemblance to music as we know it, it also destabilizes our very identity as listeners. There is no visual and spatial center on which we can focus our attention; we are rather immersed in the phenomenon. Instead of thematic development or harmonic tension, we perceive a vast, glacial metamorphosis of sound. Finally, and most importantly, what we hear is not the expression of the composer's creative intentions, but of the acoustic properties of the assembled physical material. Tudor's *Rainforest*, in short, is emblematic of the question at the heart of this essay: what differentiates music from mere sound?

---

[1] John Keats, "On the Grasshopper and Cricket."

[2] For a good overview of *Rainforest* and its different versions, see John Driscoll and Matt Rogalsky, "David Tudor's *Rainforest*: An Evolving Exploration of Resonance, *Leonardo Music Journal* 14 (2004), 25-30.

The basic, if self-evident, first proposition of our investigations here is that *historically speaking, music is not coterminous with sound*. Just as the vocabulary and grammatical forms of language impose an arbitrary structure on the phenomenal world—what Benjamin Lee Whorf called the "segmentation of nature"—systems of music theory and practice bring about a particular selection of the infinite universe of sound.[3] This distinction results from an act of mediation between human culture and the natural world. This mediation, in turn, is determined in large part by the technologies with which humanity shapes its reality at any given historical moment. Music has been variously defined at different moments in the history of the West, and each conception of music represents the crystallization of a particular (and often implicit) understanding of the relation between humanity and the world it inhabits.

In this paper, I outline three broad phases in the Western conception of music. The first phase is dominated by the legacy of Pythagoras. The Pythagoreans believed that the essence of music was to be found in the numerical proportions underlying the phenomenon of pitched sound. Thus music was defined as a very particular type of sound, one whose ephemeral qualities could be reduced to definite measurable quantities. Because these same proportions were thought to be the basis of reality as a whole, Pythagorean thought placed music at the center of things, even as it strictly differentiated music from sound as such.

In the second phase, modern empirical science becomes the dominant mode of thought. Here music and number are still entwined, but the meaning of this affinity is significantly altered. Where number was once revered as the ontological substrate of reality, it is now reconceived simply as a means of describing what exists. Number is denatured and humanized, and music, as a manifestation of numerical forms, is increasingly thought of as an artifact of human culture,

[3] Quoted in John Hollander, *The Untuning of the Sky* (New York: Norton, 1970), 10.

rather than an inherent phenomenon of nature. While Pythagorean thought is never entirely extinguished, it is no longer dominant, and finds expression more often among literary figures than among composers and musicians.

The third phase is ushered in with the technological innovations of the late nineteenth century, as devices such as the phonograph and microphone bring about a new configuration between humanity, music, and nature. Previously, musical sound had been defined as that which could be quantified and which lent itself to the schematic organization of notation and instrument-building. Now technology made it possible to hear, capture, and manipulate any sound event. The result is a renewed sense of the ambient musicality of the world, but without the number mysticism that characterized the Pythagorean tradition.

Two brief caveats should be stated at the outset: first, the phases outlined above relate to each other not only successively, but also cumulatively. Varying and often contradictory conceptions of music may be operative at a given historical moment. Second, the context in which these ideas unfold is primarily that of philosophers, theorists, and musicians, rather than listeners, and the occasional apparent universality of the argument should be qualified accordingly.

I

"Musicology has been called the youngest of the sciences of art, but it is in truth the oldest." [4]

According to legend, Pythagoras discovered the numerical basis of sound when he realized that the pitch intervals between the clangs he heard in a blacksmith's shop were related to the weights of the various hammers being used. But it wasn't merely the science of music that was born in Pythagoras' apocryphal forge. Pythagoras' attempt to relate our sensations of the

[4] Walter Wiora, *The Four Ages of Music* (New York: Norton, 1965), 76.

physical world to underlying numerical forms represents nothing less than the inauguration of the scientific worldview: "The spectacular success of the Pythagorean revolution in natural science…consisted in giving up the attempt to explain the behavior of things by reference to the matter or substance out of which they were made, and trying instead to explain their behavior by reference to their form, that is, their structure regarded as something of which a mathematical account could be given."[5] It should thus come as no surprise that an essentially rationalist and mathematical conception of musical sound has predominated in Western thought, for the "mathematization of nature" underlying the scientific mastery of the phenomenal world began with Pythagoras' harmonious blacksmith.[6] Music was the first conquest of scientific thought, and not coincidentally: if the goal of philosophy was to comprehend the real, and the real was understood to be the unchanging, then the fleeting inscrutability of sound was a fitting microcosm of nature as a whole. Sound, before all other phenomena, seemed to demand explanation in terms of something constant and real, and this was provided by number. Aristotle explains:

> The so-called Pythagoreans applied themselves to mathematics, and were the first to develop this science; and through studying it they came to believe that its principles are the principles of everything. And since *numbers* are by nature first among these principles, and they fancied that they could detect in numbers, to a greater extent than in fire and earth and water, many analogues of what is and comes into being…and since they saw further that the properties and ratios of the musical scales are based upon numbers, and that numbers are the ultimate things in the whole physical universe, they assumed the elements of numbers to be the elements of everything, and the whole universe to be a proportion or number.[7]

[5] R.G. Collingwood, *The Idea of Nature* (1945; reprint, Westport: Greenwood Press, 1986), 53-54.
[6] This phrase is Edmund Husserl's; quoted in F. Joseph Smith, *The Experiencing of Musical Sound* (New York: Gordon and Breech, 1979), 93.
[7] Aristotle, quoted in Paolo Gozza, "Introduction," in Paolo Gozza, ed., *Number to Sound: The Musical Way to the Scientific Revolution* (Dordrecht: Kluwer Academic Publishers, 2000), 2.

As Norman Cazden points out, the Pythagorean teachings do not tell us how to play music; they tell us "what happens before the music is sounded." But the influence of Pythagoreanism on Western music runs deeper than "a scientific prescription for tuning."[8] *The Pythagorean doctrine does not merely determine proper relations among the elements of music; it determines the very nature of those elements.*Intuitively, before there can be ratios between tones, there must be the tone itself. But in fact, it may be argued that the Greek notion of *harmonia* as proportional relation preceded—and even helped to create—the tone as the henceforth self-evident atom of musical structure.[9] To conceive of musical intervals as whole-number ratios (e.g., the octave as 2/1 or the fifth as 3/2) requires the definition of musical sounds as numbers, that is, as determinate periodic vibrations. Thus the tone is defined in accordance with the requirements of *harmonia*, i.e., proportionality, in such a way as to be related to other sound-quanta in terms of mathematical commensurability. The tone, as the basic unit of music, is determined by the needs of the overarching system, which demands that it be periodic, constant, and measurable. For if *harmonia* holds the world together, everything in existence must be a quantity. As the second-generation Pythagorean philosopher Philolaus explains: "And indeed all the things that are known have number. For it is not possible that anything whatsoever by understood or known without this."[10]

Pythagorean music theory, in various guises and with differing cosmological inflections, dominated Europe for roughly two millennia. For the medieval music theorist Boethius, whose

---

[8] Norman Cazden, "Pythagoras and Aristoxenus Reconciled," *Journal of the American Musicological Society* 11, no. 2-3 (1958): 101.

[9] *Harmonia*, in addition to its extramusical sense of "fitting together," refers to musical proportion, but in a general way, and not strictly to simultaneously sounding "harmonies," as our use of that word suggests.

[10] Quoted in Carl A. Huffmann, "The Pythagorean Tradition," in *The Cambridge Companion to Early Greek Philosophy*, ed. A. A. Long (Cambridge: Cambridge University Press, 1999), 81.

sixth-century treatise *De institutione musica* conveyed ancient learning to the Middle Ages and beyond, the influence of Pythagoras manifested as the imperative to perceive the proportional order underlying the phenomenal surface of music: “The power of the mind should therefore be directed to the purpose of comprehending by science what is inherent in nature. Just as in seeing, the learned are not content to behold colors and forms without investigating their properties, so they are not content to be delighted by melodies without learning what pitch ratios render them internally consistent.”[11] Music, in medieval thought, is all but synonymous with Pythagorean numerical speculation, and the theoretical definition of musical sounds as quanta is firmly ensconced in medieval thought: “The *ars musica* of medieval times…relied on a philosophy of number as its rational basis. […] It is into this intellectualist grid that raw sound must be fed to emerge as *musica sonora*, i.e. as musical sound, based not just on raw sound but on numbered sound, as metaphysical and mathematical. It is not living sound itself that tells us what sound is; it is theoretical speculation that does.”[12] In the anonymous ninth-century treatise *Musica enchiriadis*, pitches are compared to letters: they are “basic elements, and the totality of music is encompassed in their ultimate realization.” But the author adds, crucially, that “pitches…are not just any kind of sound, but those which are suitable to melody by legitimate spacing between themselves.”[13] The universe of sound is thus divided into the properly musical elements of *sonus*

---

[11] Quoted in Oliver Strunk and Leo Treitler, eds., *Source Readings in Music History*, revised edition (New York: W. W. Norton & Co., 1998), 140. Compare Umberto Eco: “In Boethius we find…a very typical feature of the medieval mentality: when he speaks of ‘music’ he means the mathematical science of musical laws.” (*Art and Beauty in the Middle Ages* [1959; trans. Hugh Bredin, New Haven: Yale University Press, 1986, 30.])

[12] Smith, 40. See also 169: “For medieval music has to do not just with “being” but with “numbered being.” It is only in being “processed” though a metaphysics of number and proportion that raw sounds can emerge as the building blocks of music. Thus not raw sound but metaphysico-mathematical categories are responsible for what medieval theorists called music, as an art.” The Latin term *modulatio* (measuring) was often used interchangeably with *musica*. See Strunk, 141 fn.

[13] Strunk, 189.

numeratus or "numbered sound"[14]—that is, "pitches," "notes," or "tones"—and the sonic detritus of unpitched noise.[15]

Although Pythagorean number mysticism would never subside completely, beginning in the early seventeenth century speculative music theory, which accords number a constitutive role in the fabric of the natural world, gave way to empirical acoustics, in which number becomes reconceived as a means of describing the phenomenon of sound. Already in the late sixteenth century, Vincenzo Galilei conducted a number of acoustic experiments that undermined the old verities of music theory by showing that the particular composition of sounding bodies complicated the purity of the Pythagorean ratios. As Claude Palisca explains, "It was assumed that ratios produced the same consonances whether the numbers applied to string lengths, bores of pipes, weights stretching strings, weights of disks, or volumes of air in vessels such as bells or

[14] See Smith, 97 ff.

[15] "The pitchless sounds of nature—such as the splashing of water, the creaking of doors and the crackle of flames—are rarely mentioned in philosophical discussions of sound. […] The nearest one comes to finding a description of random noise is not in the work of a philosopher or natural scientist, but in the music theorist Johannes Afflighemensis [fl. early 12th century], who divides natural sounds into 'discrete' sounds—i.e., musical intervals as produced on stringed instruments, bells and organs, and 'indiscrete' sounds, such as human laughter, groaning, barking and roaring, whistles and children's instruments. For discrete sounds he would prefer, with Boethius, to reserve the Greek term *phthongoi*, and these alone can be the object of musical study. Only stupid men say that 'any sound is music'." (Charles Burnett, "Sound and Its Perception in the Middle Ages," in *The Second Sense: Studies in Hearing and Musical Judgment from Antiquity to the Seventeenth Century*, ed. Charles Burnett, Michael Fend, and Penelope Gouk [London: The Warburg Institute, 1991], 47-48.) There is an intriguing etymological thread here, which I am by no means qualified to investigate. The author of *Musica enchiriadis* refers to "pitches (*ptongi*) of sung speech, which the Latins call sounds (*soni*)." The Greek word *phthongos* (pl. *phthongoi*), which the author Latinizes as *ptongus* (pl. *ptongi*), eventually died out as a distinct term in Western music theory, though it lives on in words such as "diphthong." Its uses in Greek trace a fascinating history of the phenomenology of sound, as summaraized by John Wriggle: "[*Phthongos* means], loosely, 'pitch,' 'voice,' or 'measured tone.' In *The Odyssey*, Homer uses phthongos in referencing to the Sirens' enchanting voices; in Greek music taxonomy, Ptolomy (second century) defined *phthongoi* as a note retaining one and the same tone (*tonos*). He explains that this tone has no ratio (for which two differing terms are required), and that the qualities of 'melodic' and 'unmelodic' are determined by such a ratio between tones; high pitch recalled the howling of wolves, low pitch the moaning of cattle. Boethius (sixth century) defined phthongos as the melodic instance of pitch, and also paralleled its meaning to spoken words (φθέγγεσθαι). Hucbald's *De Harmonica Institutione* (ninth century) later defined phthongos more broadly as 'those sounds through which, as elements, the ancients deemed that one should approach music,' and referred to *phthongi* as components of scalar systems (reserving the term 'tone' for intervallic measurement)." John Wriggle, "Phthongos," *History of Music Theory*, 11 December 2006 , http://historyofmusictheory.blogspot.com/ (accessed 18 July 2008).

water-filled glasses. […] Actually…the ratios are not the same in these cases as in the division of the string. Throughout the Middle Ages and early Renaissance […] almost every author on music recounts the experiments of Pythagoras without realizing their improbability."[16] As soon as one strays from the clinical simplicity of the monochord, it becomes clear that the relations between pitch and number are anything but straightforward: "musical ratios are contingent on the particular dimensions and material structures of the instruments that are variable in their construction and so yield *inexact* ratios. In such cases, there are no perfect, immutable sounding numbers that stabilize music, only the variability of lines, surfaces, solids, gut, steel, copper."[17]

Not only did the numbers become much more complicated when the particularities of the sounding materials were taken into account; over the course of the seventeenth century, the very meaning of mathematics underwent a radical metamorphosis. Whereas the exponents of *sonus numeratus* envisioned number as the generative principle of sound, the new science was inclined to view number simply as a means of describing and understanding sound, the causes of which were now to be sought in the mechanistic interplay of material bodies.[18] Thus, according to Vincenzo Galilei, "numbers were not sonorous in themselves…but had to be 'applied to some sonorous body'." This view would come to dominate the emergent science of sound in the seventeenth century. Discussing the work of the French scholar Marin Mersenne (1588-1648), who along with Galileo is credited with launching experimental acoustics, Paolo Gozza writes that "[for Mersenne] the sounding number is not what mathematicians abstractly consider,

[16] Claude V. Palisca, "Music and Science," in *Dictionary of the History of Ideas* Vol. 3 (New York: Scribner and Sons, 1973-74), 261.
[17] Daniel K.L. Chua, "The disenchantment and re-enchantment of music. Vincenzo Galilei, modernity, and the division of nature," in *Music Theory and the Natural Order from the Renaissance to the Early Twentieth Century*, ed. Suzannah Clark and Alexander Rehding (Cambridge: Cambridge University Press, 2001), 23.
[18] See Gozza, 12-13.

'absque materia' ('without matter'): the number does not produce sound. For Mersenne and Galileo the sounding number denotes the number of periodic vibrations of the air."[19]

From a modern perspective, the Pythagorean tradition is often depicted as a curious eccentricity in the history of Western music, rendered irrelevant on account of its dubious mystical associations. But the underlying principle of Pythagorean musical thought—that amidst the seemingly infinite spectrum of possible sound phenomena, only that which is quantifiable is real—was bequeathed intact to posterity.[20] Though the metaphysical meaning of number underwent massive changes, the basic postulate remained that musical sound is that which is regular, periodic, and measurable. In the wake of modern empirical science, number lived on, but its role was changed. No longer the indwelling principle of the natural world, number was now the means by which the movements of the world-machine could be calculated and controlled. Indeed, the process Max Weber called the "rationalization of music" accompanied the decline of Pythagorean thought in Europe during the seventeenth and eighteenth centuries.

This can be briefly traced in two distinct but related domains of music development. The first is notation. According to Weber, "The specific conditions of musical development in the Occident involve, first of all, the invention of modern notation. […] A somewhat complicated modern work of music…is neither producible nor transmittable nor reproducible without the use of notation. It cannot exist anywhere and in any form at all, not even as an intimate possession

[19] Gozza, 60-61,
[20] As Walter Wiora elaborates, "Western musical art was impregnated as no other by scholarly and, in the broad sense, scientific theory. In mensural rhythm, in the rules governing tonality, in harmony it was rationalized through and through. The seemingly irrational world of tone was laid down *imperio rationis*—under the command of reason, as was said following Boethius—in concepts and written signs. There took shape systems of relationship and forms of representation, like the coordinating system of the score, metrical schemes using barline and time signature, the well-tempered keyboard. More than anywhere else music was objective spirit and *scientia musica*." *The Four Ages of Music*, 127.

of its creator."[21] The development of polyphonic music in Europe after the turn of the second millenium required a notational means of relating the two or more voices in time; thus there emerged a succession of fascinating and often extremely complicated systems of rhythmic notation. Likewise, the notation of pitch, which originally took the form of neumatic squiggles above a printed text, moved in the direction of precise determination of pitch level, with the introduction first of a single line indicating a reference pitch, then multiple lines, and finally the more or less modern system of lines and spaces. Originally used in order to document performances that were largely improvisatory, notation increasingly took on a prescriptive character, and can eventually be seen as a technological determinant of musical reality. Daniel Chua argues that by the year 1600 or so "the typography [of notation] looks like a system of coordinates that locates and cages the pitches for the surveillance of the modern eye. […] The score rationalizes the fissured and layered patterns of medieval notation by containing music within a geometrical space that pictures the totality as a map."[22]

The second arena of musical rationalization is tuning and instrumental design. With the increasing prominence of instrumental music, either on its own or as accompaniment for singers, problems of tuning became more and more acute. Just as the emergence of polyphonic practice demanded the development of more precise musical notation, the ubiquity of instrumental music required a system of tuning that allowed various instruments to play together in euphony. Thus the whole number ratios of Pythagorean tuning, which are mathematically pure within a single key but result in howling dissonances when one moves beyond the basic diatonic intervals, gave

[21] Max Weber, *The Rational and Social Foundations of Music* (1921; trans. Don Martindale, Johannes Riedel, and Gertrude Neuwirth, Carbondale: Southern Illinois University Press, 1957), 84.
[22] Daniel K. L. Chua, *Absolute Music and the Construction of Meaning* (Cambridge: Cambridge University Press, 1999), 54.

way to the idea of temperament, in which the whole number ratios are compromised for the sake of musical versatility. “In its broadest meaning, any tone scale is tempered when the distance principle is applied in such a manner that the purity of the intervals is relativized for the purpose of equalization of contradictions between different interval circles, reducing distances to only approximate tone purity.”[23]

In both domains—notation and tuning—there is a “spiral of rationalization” in which theory and practice generate a feedback loop of mutual determination.[24] Having passed through the sieve of Pythagoras, sound is now emplaced in a “grid,” (F. Joseph Smith) “lattice,” (Trevor Wishart) or “cage,” (Daniel Chua) whose two-dimensional system of coordinates circumscribes the musical universe.[25] The development of Western musical thought from circa 1000 to the twentieth century witnesses a consistent increase in the “resolution” of the represented quanta: in the pitch dimension, for example, there is the progression from hexachord, to modality, to major/minor tonality, to chromatic tonality, to atonality, to microtonality in the twentieth century. As Trevor Wishart notes, even the developments in twentieth-century music associated with the Viennese School and the postwar avant-garde of the 1950s represented not so much a radical break with the tendency of Western music as its logical consummation. “The final step into a twelve-tone and thence ‘integral’ serial technique, rather than being a liberation from this

[23] Weber, 97.

[24] Don Martindale and Johannes Riedel, “Introduction,” in Weber, xlvii.

[25] Although tendencies toward lattice-based rationalization undergo a marked intensification in the seventeenth century, it would be a historiographical error to suggest that this entails a corresponding shift in musical perception. There is little reason to believe that a theoretical and notational conceptualization of music that encouraged a strictly two-dimensional perception in terms of pitch and duration. Instead, the two-dimensional musical mindscape of modernity has a proleptic character: by establishing itself as musical reality—the permanence of ink and parchment against the phantasms of sound and perception—the lattice begins at once to legislate the terms in which music can be thought.

restricted-set tonality, should be seen in historical perspective as the final capitulation to the finitistic permutational dictates of a rationalistic analytic notation system."[26]

II

"But a musical note is the foundation of all music." [27]

In defining music as *sonus numeratus*, European music theory lay down a dividing line between musical sound or "tone" and unmusical sound or "noise." It is tempting to see this dichotomy as a parallel to the duality of the artificial and the natural: tone is "discovered" and cultivated by man, while noise predates him and characterizes the world of sound apart from human intervention. But even if the note is not found in nature, it would be wrong to say that Pythagoras effected a split between "artificial" and "natural" sound. For the numerical structure that characterized artificial musical sound was understood to be nature itself, in the Greek sense of *physis*—the indwelling principle in things that makes them what they are. As long as number was bound up with the divine essence of the universe, the "mathematization of nature" did not mean the demusicalization of nature. But with the gradual waning of Pythagorean thinking over the course of the seventeenth and eighteenth centuries and the ascendance of a mechanical, rather than organic, model of the world, the musicality of nature was called into question.[28] Number in the modern worldview is no longer the cosmic glue linking the concentric circles of *musica mundana*, *musica humana*, and *musica instrumentalis*; instead, number (again, in the sense of periodicity of pitch) is what distinguishes artificial, musical sound from the rude noises of the world at large.

---

[26] Trevor Wishart, *On Sonic Art* (New York: Routledge, 1996), 31-32.

[27] Eduard Hanslick, *On the Beautiful in Music* (1854; trans. Gustav Cohen, Indianapolis: Library of Liberal Arts, 1957), 109.

[28] See Collingwood.

Modern theory and aesthetics would draw an ever firmer boundary between the sounds of the phenomenal world and those of human origin. Indeed, the distinction between the natural and the artificial comes to parallel that between noise and tone: In many Enlightenment accounts of the historical development of music, the gradual emergence of tone from a primal morass of undifferentiated sound is thought to follow the presumed ascent of civilization from the barbaric state of nature. Writing at the end of the eighteenth century, the German historian Johann Nikolaus Forkel proclaimed that "entire peoples have loved and practiced music for hundreds of years without coming to an awareness of the primary distinctions discernable in tones. […] The very first music of rough and uncultivated nations was nothing more than a noisy clamoring without regard to any of the endless modifications that music allows."[29] For Forkel, the "natural" is associated with the primitive, as both the origin and antithesis of Enlightened musical culture. Primitives do not understand the distinction between tone and noise:

> Although tone—or rather, as it must be called at this juncture, sound—is only the means by which music is made perceptible, in primitive, uncultivated nations it is generally taken for the thing itself. Indeed [primitive people] consider every individual sound to be music. […] This explains why we find in all wild and uncivilized nations such great pleasure taken in the clamor of noisy instruments—in drums, for example, and rattles, in blaring trumpets, and extremely loud, ferocious shrieks.[30]

For Eduard Hanslick, writing in the 1850s, "nature music" and "primitive music" were interchangeable and equally void of genuine musical significance: "When South Sea islanders rattle wooden staves and pieces of metal to the accompaniment of fearful howlings, they are performing natural music, that is, no music at all."[31] According to Hanslick, nature provides the

[29] Quoted in Strunk, 1017.
[30] Quoted in Strunk, 1015-16.
[31] Hanslick, 106. The notion that music was wrested by human ingenuity out of a mute and docile nature proved to be resilient. Writing in the early 20th century, Max Weber sought to counteract the derogatory characterizations of

material basis of music only in a literal sense: “The silent ore of the mountains, the wood of the forest, the skin and gut of animals, are all that constitute the raw material, properly so-called, with which the musical note is formed.” But music does not consist of physical matter. This raw material is the basis for the production of the *actual* material of music, which is “sound of high or low pitch; in other words, measurable tone.” Thus there is a twofold mediation, from the tangible stuff of which instruments are made to the tones produced by those instruments, and from these tones to music. Though music is built on a foundation provided by nature, its two definitive elements, melody and harmony, are “[not] provided for us by nature ready-made, but both are creations of the human mind.” Natural sound cannot be quantified, and as such it is banished from the domain of music: “Sound phenomena in unassisted nature present no intelligible proportions, nor can they be reduced to our scale.”[32] Rhythm, unlike melody and harmony, can be heard in nature, but rhythm can have no musical value on its own—and in any event, it “cannot be reduced to a definite quantity.” After having laid out his distinction between natural and musical sound, Hanslick confronts head-on the cherished Romantic conception of “nature music”:

> To disprove our assertion that there is no music in nature, the wealth of sound that enlivens her is generally cited as counterevidence. Should not the murmuring brook, the roar of the ocean waves, the thundering avalanche, and the howling of the wind be at once the source of and the model for human music? Have all these rippling, whistling, and roaring noises nothing to do with our system of music? We have no option but to reply in the negative. All such sounds are mere noise, i.e., an irregular succession of sonorous pulses. Very seldom, and even then only in an isolated manner, does nature bring forth a musical note of definite and measureable pitch.[…] As everything in music must be measurable, while the spontaneous sounds of nature cannot be reduced to any definite quantity, these two realms of

non-Western music, claiming that “the assumption must be abandoned that primitive music is a chaos of arbitrariness.” (Weber, 34) But Weber supports this statement with the observation that “primitive music” exhibits many of the same features of tonal organization as does Western music.

[32] Hanslick, 105.

> sound have no true point of contact. Nature does not supply us with the art elements of a complete and ready-made system of sound, but only with the crude matter which we utilize for our music. Not the voices of animals but their gut is of importance to us; and the animal to which music is most indebted is not the nightingale but the sheep.[33]

Thus the contribution of nature to music goes no further than the provision of physical matter. The way from nature to music is not through the mimesis of natural sound, but through the technical mastery of natural material, which converts mute, dead matter (sheepskin, wood, metal) into artificial instruments of tone production. “The ‘music’ of nature and the music of man belong to two distinct categories. The transition from the former to the latter passes through the science of mathematics.”[34] Hanslick’s scare-quotes make clear his intention to unmask the music of nature as mere noise, the antithesis of music.

The fierceness of Hanslick’s criticisms suggests that even in the middle of the nineteenth century, the tradition of nature music lived on. And indeed, existing alongside with the Pythagorean tradition, and to some extent overlapping with it, was a very different notion of sound. The idea of nature music was fueled by the simple observation that sound was produced by movement. Cicero’s famous *Dream of Scipio* declares of the heavenly orbits, “Such mighty motions cannot be carried on so swiftly in silence.”[35] According to R. G. Collingwood, the Greeks viewed nature essentially as an organism, self-perpetuating and regenerating according to an indwelling *telos* or goal. Sound would thus be a necessary byproduct of the organic processes of nature.[36] This view survived into the Christian Middle Ages and beyond. The Jesuit scholar Athanasius Kircher declared in 1650 that “nothing is more obvious than sound in this terrestrial

---

[33] Hanslick, 109-10.
[34] Hanslick, 110.
[35] Quoted in Hollander, 30.
[36] Collingwood, 3-4.

theatre of things."[37] 150 years later, Johann Gottfried Herder would celebrate nature as "an *odeum*, a hall of eternal harmonies."[38] Whereas the Pythagorean tradition drew a hard line between "tones" and "noises," nature music encompasses with sound as a whole. While the former sees the significance of music in the numerical order that underlies it, the latter celebrates sound as a primal expression of motion and life.

Perhaps the best example of nature music is birdsong. The idea that humans learned to sing by imitating the warbling of birds is among the oldest accounts of the origins of music: According to the Roman poet Lucretius (first century B.C.), "by the mouth to imitate the liquid notes of birds was earlier far 'mongst men than power to make, by measured song, melodious verse and give delight to ears."[39] Birdsong is often mentioned alongside various other noises in account of the sound of nature, suggesting that the notion of "voice" or the living quality of sound may have been a secondary consideration.[40] (Following the quote given above, Lucretius adds, "and whistlings of the wind athrough the hollow of the reeds first taught the pleasantry to blow into the stalks of hollow hemlock-herb.") Around 1300, Aegidius of Zamora mused over the possibility of music originating in "the buffeting of wind in the vaulted forest, where there are certain sweet rustlings to be heard, especially at night, [or] the sound of waters and the striking of wind upon cliffs and other rocky places."[41] The eighteenth-century music historian John Hawkins, glossing older accounts, summarizes the argument for the natural origins of

[37] Quoted in James W. McKinnon, "Jubal vel Pythagoras, quis sit inventor musicae?," *The Musical Quarterly* 64, No. 1 (1978), 20.
[38] Johann Gottfried Herder, *Kalligone*, ed. Heinz Begenau (Weimar: Hermann Böhlaus Nachfolger, 1955), 37.
[39] Lucretius, *Of the Nature of Things*, trans. William Ellery Leonard (New York: E.P. Dutton & Co., 1957), 242-43.
[40] "Voice" is famously discussed in Aristotle's *De anima*, Book II, Part 8: "Voice is a kind of sound characteristic of what has soul in it; nothing that is without soul utters voice, it being only by a metaphor that we speak of the voice of the flute or the lyre of generally of what (being without soul) possesses the power of producing a succession of notes which differ in length and pitch and timbre. Voice is the sound made by an animal, and that with a special organ."
[41] Quoted in Strunk, 247.

human music: "The voices of animals, the whistling of the winds, the fall of waters, the concussion of bodies of various kinds, not to mention the melody of birds, as they contain in them the rudiments of harmony, may easily be supposed to have furnished the minds of intelligent creatures with such ideas of sound, as time, and the accumulated observation of succeeding ages, could not fail to improve into a system."[42] The question of course remains, in what sense natural sounds can be called music: even the writers who so enthusiastically catalog them seem hesitant to use the term. It may have been this conundrum that led many eighteenth-century historians to abandon the idea that music had its origins in the human imitation of birdsong. Instead of having its impetus in external nature, music was now thought to be the pure efflux of human feeling. For Hanslick, not surprisingly, there could be no reconciliation between the sensuous but undisciplined sounds of nature and the mathematical order of human music: "Even the purest phenomenon in the natural world of sound—the song of birds—has no relation to music, as it cannot be reduced to our scale."[43] It seems likely that the strict distinction between "music" and "non-music," as between "tone" and "noise," is a legacy of the Pythagoreanism. In the nature music tradition, on the other hand, the significance of sounds is constituted not by their demonstrable proportionality, but by the sheer fascination they elicited in the human ear and mind.

Though a rationalist and mechanistic view of nature was in the ascendant by the year 1800, other traditions were by no means vanquished. Indeed, certain musical trends in the first part of the nineteenth century show the enduring allure of the idea of nature music. As Melanie Wald has pointed out, many Romantic intellectuals who sought to escape the "disenchanted world" of

---

[42] Quoted in Matthew Head, "Birdsong and the Origins of Music," *Journal of the Royal Musical Association* 122, No. 1 (1997), 17.
[43] Hanslick, 109.

post-Enlightenment modernity found solace in the writings of seventeenth-century thinkers such as Kepler, whose Pythagorean inclinations the Romantics found highly sympathetic.[44] (Ironically, Pythagorean mysticism was now seen as a remedy for the analytic disintegration of nature wrought by modern science.) Writing in the 1830s, as industrialization was setting in on the European continent, the German poet Joseph Freiherr von Eichendorff articulated the sense of a universal music lurking just beneath the surface of mundane reality:

Schläft ein Lied in allen Dingen	There sleeps a song within all things
Die da träumen fort und fort.	Mute and dreaming, never heard.
Und die Welt hebt an zu singen	And the world shall start to sing
Triffst du nur das Zauberwort.	If you but speak the magic word.[45]

In E.T.A. Hoffmann's 1814 short story *Die Automate* (*The Automata*), the protagonist Ludwig, after a disturbing encounter with an android orchestra, launches into a highly speculative dialogue with his friend Ferdinand about the proper ends of musical technology. "It would be the task of a really advanced system of the 'mechanics of music,'" he states, "to observe closely, study minutely, and discover carefully that class of sounds which belong, most purely and strictly, to Nature herself, to obtain a knowledge of the tones which dwell in substances of every description, and then to take this mysterious music and enclose it in some sort of instrument where it should be subject to man's will, and give itself forth at his touch.[46] The goal of such a science is not to create mechanical musicians, but rather "the discovery of the marvelous acoustical secrets which lie hidden all around us in nature."[47] Hoffmann's

[44] Melanie Wald, *Welterkenntnis aus Musik: Athanasius Kirchers „Musurgia Universalis" und die Universalwissenschaft im 17. Jahrhundert* (Kassel: Bärenreiter, 2006), 186.
[45] Quoted in Wald, 192. Translation by the author.
[46] E.T.A. Hoffmann, "Automata," in *The Best Tales of Hoffmann* (New York: Dover, 1967), 96.
[47] Hoffmann, 96.

experimental acoustics is not meant to furnish scientific data; it is instead part of an aesthetic quest for “the most absolutely perfect kind of musical sound; and according to my theory, musical sound would be the nearer to perfection the more closely it approximated such of the mysterious tones of nature as are not wholly dissociated from this earth.”[48] Hoffmann’s nature music is a kind of inverted Pythagoreanism: instead of a cosmic musical order which finds its apotheosis in the orbit of the heavenly spheres, he proposes a chthonic instrumentarium lying enclosed in physical matter and waiting to be unearthed. The material of music is generated not by the abstract measuring of quanta, but rather through the experimental probing of nature. As Emily Dolan has noted, Hoffmann’s nature music was no baseless fantasy of his febrile imagination. Dolan suggests that the effusion of new and often bizarre instruments invented in the late eighteenth and early nineteenth century can be seen as a practical realization of the ancient belief in musical pantheism:

> The notion that the universe was thoroughly musical was hardly novel; celestial harmony had played an important role in history since antiquity. What was new about Hoffmann, Wackenroder and Tieck’s invocation of a divine musical spirit realm was the idea that this heavenly music could be accessed, in a practical and immediate way. Mankind could actually *hear* the ethereal music of nature. […] Aeolian harps and glass harmonicas transformed a music that was theoretical into something tangible; ‘nature music’ was inescapably technological.[49]

This conjunction between nature music and technology represents a radically new idea of the relationship between humanity, music, and nature. For if Hanslick saw nature as providing the raw material from which human labor creates the artificial product of music, Hoffmann envisaged music leading as an experiential and epistemological encounter with the world of

[48] Hoffmann, 97.
[49] Emily I. Dolan, ‘E.T.A. Hoffmann and the Ethereal Technologies of ‘Nature Music’,” *Eighteenth-Century Music* 5, no. 1 (2008), 25-26.

nature. What Hoffmann was after was expressed 150 years later in the words of John Cage, who sought to discover "the meaning of nature through the music of objects."[50]

III

"And from above, thin squeaks of radio static, / The captured fume of space foams in our ears." [51]

If it was the technology of number—what I call the sieve of Pythagoras—that lay the groundwork for Western musical development and set the parameters of its unfolding, it was a later stage of technology that ushered in the totality of sound in the twentieth century. The boundaries between music, sound, and noise were radically redrawn in the wake of the new sonic technologies that began appearing in the late 1800s. The microphone and the phonograph in their myriad forms created a new relationship between human beings and sounds. As we have seen, the phenomenon of sound was a fitting symbol of the world confronted by the natural philosophers of ancient Greece. Behind its fleeting manifestation, they sought something enduring and real. For Pythagoras and his followers, the essence of sound (as of nature itself) was number. Alongside and often against the messier and more expansive conceptions of auditory experience, ancient and medieval theorists marked off the domain of music as *sonus numeratus* or "numbered sound." But this process was not merely conceptual. As always, understanding is bound up with control. The mathematization of sound not only satisfied the philosophical dictate that the real is the unchanging; it also brought the refractory phenomenal world under the dominion of scribal calculation. Notation itself functioned as a kind of phonography *avant la lettre*, allowing for the extra-temporal control of sounds through the

[50] Quoted in Douglas Kahn, *Noise Water Meat: A History of Sound in the Arts* (Cambridge, MA: MIT Press, 1999), 196.
[51] Hart Crane, "Cape Hatteras"

manipulation of their graphic doppelgangers. Twentieth-century sound technology can thus be seen to continue the basic project of mastery over nature inaugurated by Pythagoras and put into overdrive by the emergence of experimental science in the seventeenth century. But whereas notation inscribed only those sound phenomena that could be symbolically represented, the new technologies promised to capture "the sound itself."

The significance of the microphone for music must be judged equivalent to that of the microscope or telescope for science, and its history goes back as far. For seventeenth-century figures such as Milton and Shakespeare, the inability to modern man to hear the music of the spheres stemmed from the trauma of the Fall.[52] Meanwhile, however, their contemporaries were investigating how the *musica mundana* might be heard through the "natural magic" of auditory prosthesis: Tomaso Campanella envisaged an aural equivalent to the telescope which "would one day make possible the perception of the music of the spheres," while Athanasius Kircher imagined something akin to a sonic microscope, a "special instrument for the ear" which might render audible the otherwise silent sounds caused by the "incessant motion" and collision of physical bodies.[53] In 1684, a certain Mr. Marsh, a member of the Royal Society, prophesied that "microphones…shall render the most minute sound in nature distinctly audible."[54] The knowledge that such sounds existed encouraged the eager listener to pay closer attention to these tiny, ambient symphonies. To experience nature's microphonic music was to hear the world

---

[52] "But whilst this muddy vesture of decay / Doth grossly close it in, we cannot hear it." Shakespeare, quoted in Hollander, 200.

[53] Lorenzo Bianconi, *Music in the Seventeenth Century*, trans. David Bryant (Cambridge: Cambridge University Press, 1987), 54; Athanasius Kircher, *Musurgia Universalis* (1650), reprint of 1662 German translation (Kassel: Bärenreiter, 1988), 12-13: "Aus dieser immerwärenden Bewegung entsteht die Zusammenstossung der Leiber: aus dieser collision, nach dem die corpora sonora beschaffen sind, entstehen die unendlich Varietäten sonorum, welche zwar nicht allezeit, aber wohl könnten vernommen werden, wenn das Gehör entweder durch höhere Göttliche Kraft, oder vermittelst eines sonderbaren Ohr-Instruments, corroboriert und gestärkt würde."

[54] Quoted in Penelope Gouk, *Music, Science, and Natural Magic in Seventeenth-Century England* (New Haven: Yale University Press, 1999), 185.

order writ small, as Goethe attests: "When I hear the humming of the little world among the stalks, and am near the countless indescribable forms of the worms and insects, then I feel the presence of the almighty, Who created us in His own image…."[55] As soon as it was realized that the realm of human hearing is smaller than the realm of sound as such, the microphone held out the promise of revealing a hitherto undisclosed array of "subsonic" sounds.[56]

In addition to hearing *better*—that is, making louder what is already audible—the microphone also heard *more*. Technology determines ontology: "The more powerful the telescopes, the larger the number of stars is going to be."[57] Conversely, the existence of a subsonic realm of sound compels the investigation of the "impossible inaudible": the hitherto unheard becomes the asymptote of ever finer auditory discrimination: "That we have no ears to hear the music the spores shot off from basidia make obliges us to busy ourselves microphonically."[58] If sound is an efflux of motion, and twentieth century physics effectively defines matter as an ephiphenomenon of energetic movement, we are presented with the reconstitution, on a modern scientific basis, of *musica mundana.*[59] Thus it is simply a question of creating a technology that allows for "the reception, amplification, and transfiguration of vibrations emitted by matter. Just as today we listen to the song of the forest and the sea so

---

[55] Quoted in R. Murray Shafer, "The Music of the Environment," in *Audio Culture: Readings in Modern Music*, eds. Cristoph Cox and Daniel Warner (New York: Continuum, 2004), 32.
[56] "Some sounds are too soft to be perceived by the human ear, such as a caterpillars delicate march across a leaf. This is the zone of *subsonic* intensities." Curtis Roads, *Mircosound* (Cambridge, Mass.: MIT Press, 2001), 7.
[57] Maurice Renard, quoted in Friedrich Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford: Stanford University Press, 1999), 53.
[58] John Cage, quoted in Kahn, 195.
[59] "[In modern physics] the dualism of matter and motion disappears. That dualism depends on thinking of motion as an accident of matter, and of matter as something having all its own inherent characteristics complete at any given moment, whether it moves or not. From this it followed that there is no inherent reason in matter why it should ever move, or why it should be at rest either; having its own nature completely realized at any given moment, it has no reason for existing at all at any other moment; which is why Descartes said that God must create the world afresh at every instant of time. But modern physical theory regards matter as possessing its own characteristics, whether chemical or physical, only because it moves: time is therefore a factor in its very being, and that being is fundamentally motion." (Collingwood, 151-52)

tomorrow shall we be seduced by the vibrations of a diamond or a flower."[60] Much twentieth-century music is driven by a radiophonic imperative to hear the ambient flux of life, whether natural or artificial:

> The air, you see, is filled with sounds that are inaudible, but that become audible if we have receiving sets…. There were [in the composition *Variations VII* (1966)] ordinary radios, there were Geiger counters to collect cosmic things, there were radios to pick up what the police were saying, there were telephone lines open to different parts of the city. There were as many different ways of receiving vibrations and making them audible as we could grasp with the techniques at hand.[61]

While the microphone extends hearing into the formerly inaudible and destroys silence, the phonograph provides a memory for the ear and collapses time. It captures sound, making artifacts of ephemera. The fleeting nature of sound had long served as a kind of *memento mori*, reminding man of his own inexorable fate. The medieval scholar Isidore of Seville famously noted that "unless sounds are remembered by man, they perish, for they cannot be written down."[62] By enabling the storage and reproduction of sound events, phonography changed the nature of sound itself. The captured sound can be studied, objectified, manipulated. Pierre Schaeffer described the sound of a broken record repeating a groove as "a fragment of life caught in a trap": "The sound, prisoner of the magnetic tape, repeats itself indefinitely just like itself, isolates itself from its contexts, comes to disclose itself in other perspectives of perception."[63] Further, the phonograph offers a certain "objectivity" of hearing. Although the quality of a recording depends on any number of technological and environmental variables, the phonograph

[60] F.T. Marinetti and Pino Masnata, quoted in Kahn, 197.

[61] Cage, quoted in Kahn, 195. Cf. Kircher's 17th century panaurality: "Just as the air is filled with innumerable images, which shimmer forth from their objects through the medium, so it is filled with innumerable *speciebus sonorum*, of which however only those present themselves to our hearing, which are borne in a proportionate measure to the auditory faculty in the ear by means of a physical motion." (*Musurgia Universalis*, 12-13)

[62] Quoted in Strunk, 149.

[63] Quoted in Daniel Albright, *Modernism and Music: An Anthology of Sources* (Chicago: University of Chicago Press: 2004), 188.

is free of the psychoacoustic filters that unconsciously govern human audition: "The phonograph does not hear as do ears that have been trained immediately to filter voices, words, and sounds out of noise; it registers acoustic events as such."[64] Phonographic technology thus promises the possibility, in the words of Gabrielle Buffet, of "an objective reconstitution of the life of sound" which enables the "[discovery of] sound-forms independently of musical conventions."[65]

But beyond the apprehension of sounds that our ears let slip, phonography suggested a further possibility: the universal transmutation of graphic traces into sound. While the microphone expanded the world of sound by amplifying tiny vibrations, the phonograph worked by means of an apparently magical analogy between grooves in wax or vinyl and sound. If the contours of a record could be read by the needle, could the same technology be used to give voice to the mute markings of the world? In Rainer-Maria Rilke's short prose-piece "Primal Sound" (*Ur-Geräusch*), written in 1919, the profound epistemological implications of phonographic technology are at once celebrated and shrouded with dread. Rilke describes his first encounter with phonographically reproduced sound as the apprehension of "a new and infinitely delicate point in the texture of reality, from which something far greater than ourselves, yet indescribably immature, seemed to be appealing to us as if seeking help."[66] Years later, as a student of anatomy, he pondered the possibility of phonographically "playing" a human skull:

> The coronal suture of the skull…has—let us assume—a certain similarity to the close wavy line which the needle of a phonograph engraves on the receiving, rotating cylinder of the apparatus. What if one changed the needle and directed it on its return journey along a tracing which was not derived from the graphic translation of sound but existed of itself naturally—well, to put it plainly, along the coronal suture, for example. What would happen?

[64] Kittler, 23.
[65] Quoted in Andrew Hugill, "The origins of electronic music," in *The Cambridge Companion to Electronic Music*, eds. Nick Collins and Julio d'Escriván (Cambridge: Cambridge University Press, 2007), 16.
[66] Quoted in Kittler, 39.

> A sound would necessarily result, a series of sounds, music…. Feelings—which? Incredulity, timidity, fear, awe—which of all feelings here possible prevents me from suggesting a name for the primal sound which would then make its appearance in the world?... Leaving that aside for the moment: what variety of lines, then, occurring anywhere, could one not put under the needle and try out? Is there any contour that one could not, in a sense, complete in this way and then experience it, as it makes itself felt, thus transformed, in another field of sense?[67]

The most seductive possibility presented by phonographic technology, according to Friedrich Kittler, was "to decode a trace that nobody had encoded and that encoded nothing."[68] Sound thus "read" is significant even though (or especially because) it is in no sense "intended"—it is the music of nature, insofar as this is understood to precede human intervention. Modern technology, the world-altering appendage of *homo faber*, paradoxically enables a "return to nature." It allows us to experience the world in its quiddity, free from the limitations of human perception.

But if technology gives us ears to hear nature, nature in turn becomes a model for hearing the manmade world. The forms of music have always been influenced by the ambient soundscape of quotidian life. When this life was closely tied with the rhythms and sounds of the natural environment, music reflected these sonorous forms.[69] But even before the Industrial Revolution, the sounds of human activity left their stamp on musical development. According to R. Murray Schafer, for instance, the ostinato figures common in the century century echoed the rhythmic patterns of horses' hooves on cobblestone.[70] With the gradual establishment of a predominantly urban, industrial society in the post-Enlightenment period, the artificial soundscape of the

---

[67] Quoted in Kittler, 40-41.
[68] Kittler, 44.
[69] "Other composers sit down at the piano until there is no way out of the confusion. I rather seek my ideas on the street or in the fresh air. Sometimes I copy a tree, a bird, or a cloud." (Joseph Haydn, quoted Frederick Dorian, *The Musical Workshop* [London: Secker and Warburg, 1947], 68)
[70] R. Murray Schafer, *The Soundscape* (Rochester, Vermont: Destiny Books, 1977), 62-63.

modern city takes the place of the bucolic voice of nature for more and more of the world's population.[71]

For the Italian Futurist Luigi Russolo, author of the manifesto *L'arte dei Rumori* (*The Art of Noises*, written in 1913), industrial noise is to modern music what natural sound was to ancient music: a reservoir and model of possible forms. "The evolution toward noise-sound is only possible today. The ear of an eighteenth-century man never could have withstood the discordant intensity of some of the chords produced by our orchestras (whose performers are three times as numerous); on the other hand our ears rejoice in it, for they are attuned to modern life, rich in all sorts of noises."[72] Russolo argued that music, in order to remain relevant in a world of noise, had to embrace the sounds of modernity:

> First of all, musical art looked for the soft and limpid purity of sound. Then it amalgamated different sounds, intent upon caressing the ear with suave harmonies. Nowadays musical art aims at the shrillest, strangest, and most dissonant amalgams of sound. Thus we are approaching noise-sound. This revolution of music is paralleled by the increasing proliferation of machinery sharing in human labor. In the pounding atmosphere of great cities as well as in the formerly silent countryside, machines create today such a large number of varied noises that pure sound, with its littleness and its monotony, now fails to arouse any emotion. […] We must break at all costs from this restrictive circle of pure sounds and conquer the infinite variety of noise-sounds.[73]

As Fred Prieberg argues, the valorization of the artificial in Futurist aesthetics suggests a powerful affinity between technology and nature: "The Futurists' 'onward to the machine' is at root the same as Jean-Jacques Rousseau's 'back to nature.' Both harbor, generate, or transform energy. Both signify primal violence, virility, youth, force, life. The airplane pilot, like Icarus, is the master of space, of gravity; he is in a certain sense like God, and…the legendary man in the

---

[71] As of 2007, according to the UN, fully half of the world's population are city-dwellers.
[72] Luigi Russolo, *The Art of Noises*, trans. Robert Filliou (N.p.: Something Else Press, 1967), 6.
[73] Russolo, 5-6.

original condition. [..] The futurists did not want to make 'machine music.' They never intended to create a simple portrait of technology or programmatic tone-painting. […] [They wanted to create] acoustic manifestations not merely of technology, but of entire domains of nature."[74] The classic example of the infusion of nature into music in the twentieth century is found in the third movement of Ottorini Respighi's orchestral piece *Pini di Roma* (*Pines of Rome*, composed in 1924), the score of which calls for a phonograph recording of a nightingale's song to be played at the end of the section: "Here, the gramophone becomes an orchestral instrument: Nature, on the disc, enters the concert hall. The little nightingale sings from the cage and pleads us to believe that all is real."[75] This instance is emblematic of the way in which technology and nature are entwined in twentieth century music: the warbling of a bird, a symbol of life innocent of human intervention, is made an object of art through the magic of machinery. Traditionally counterposed on account of their differing causal origins and tonal qualities, natural and artificial sounds are thus united as the two faces of a musical "return of the repressed." Respighi's nightingale and Edgard Varese's sirens are twin gestures of revolt against a musical world-order that had proscribed both. In *The Art of Noises*, too, there is a conspicuous absence of any categorical distinction between noises on the basis of their origins: alongside "the rising and falling of pistons, the stridency of mechanical saws, the loud jumping of trolleys on their rails," Russolo celebrates "thunder, wind, cascades, rivers, streams, leaves, a horse trotting away, the starts and jumps of a carriage on the pavement, the white solemn breathing of a city at night, all the noises made by feline and domestic animals and all those man's mouth can make without

[74] Fred K. Prieberg, *Musica ex machina. Über das Verhältnis von Musik und Technik* (Berlin: Verlag Ullstein, 1960, 33-34)

[75] Dorian, 72. The composer's direction reads, "Nº. R. 6105 del Concert Record Gramophone: Il canto dell'usignolo."

talking or singing."[76] For all their enthusiasm for the clangorous industrial soundscape, Russolo and his ilk were no less fascinated with the possibility of capturing the primal sounds of nature. The French composer Carol-Bérard in 1929 lamented the sonic wonders that had yet to be recorded:

> Why are phonograph records not taken of noises such as those of a city at work, at play, even asleep? Of forests, whose utterances varies according to their trees—a grove of pines in the Mediterranean mistral has a murmur unlike the rustle of poplars in a breeze from the Loire? Of the tumult of the crowds, a factory in action, a moving train, a railway terminal, engines, showers, cries, rumblings?... If noises were registered, they could be grouped, associated and carefully combined as are the various instruments in the routine orchestra, although with a different technique…. We could then create symphonies of noise that would be grateful to the ear.[77]

Conclusion

> *"There is a great difference between still believing something and again believing it. Still to believe that the moon influences the plants betrays stupidity and superstition, but again to believe it betrays philosophy and reflection."*[78]

Thus we have come, in a way, full circle. The technologically determined expansion of the domain of music to encompass potentially the entirety of audible phenomena—what Douglas Kahn has christened "panaurality"—represents, on one level, a return to a holistic conception of music and nature similar to that which held sway in premodern thought.[79] Few twentieth-century composers would defend Hanslick's hard-line distinction between music and noise, though some such notion retains widespread popularity among contemporary listeners. But this movement in music is symbolic of a broader tendency in twentieth-century thought as a whole. Just as

[76] Russolo, 7.
[77] Quoted in Kahn, 130.
[78] Georg Cristoph Lichtenberg, *Aphorisms*, trans. R.J. Hollingdale (New York: Penguin, 1990) 67.
[79] Kahn, 159.

Pythagoras' music-theoretical speculation represented the inauguration of the quantitative-scientific worldview, the turn toward panaurality in early twentieth-century music anticipated similar holistic tendencies in other branches of thought. To define music is to define, however obliquely, the world and our place in it.