Colloquy

Discrete/Continuous: Music and Media Theory after Kittler

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Introduction

ALEXANDER REHDING

At first blush, the pair discrete/continuous seems to take us far from the concerns of musicology and place us firmly in the realm of statistics, data analysis, and number crunching. Put graphically, "discrete data" translates into dots or interrupted lines, while "continuous data" implies a curve. This would mean counting and measuring—how can these activities be relevant to music?

Our initial association might be with computers, but it is not necessary to invoke that squishy entity called the "digital humanities" here.[1] We fare better if we think of the discrete/continuous pair in the context of a different and seemingly outmoded approach to music aesthetics. Going back in time, beyond the influential Kantian tradition, we return to Gottfried Wilhelm Leibniz (1646–1716) of almost a century earlier, the great rationalist and

1. For a media archaeology of the digital, see Siegert's magisterial *Passage des Digitalen*.

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casts Bayreuth's early cult of ossified productions in the light of a theater carrying out its own archaeology.[48]

More fundamentally, media archaeology's emphasis on the presentness of technical artifacts resonates intriguingly with music historiography. According to Ernst, not only do sonic media inhabit their own intrinsic temporal regime—their *Eigenzeit*—but media systems also defy historical time. As long as a device of the past (such as a 1940s radio transmitter) can still be operated today, "[t]here is no 'historical' difference in the functioning of the apparatus now compared to then . . . rather, there is a media-archaeological short circuit between otherwise historically clearly separated times."[49] If we substitute "notated music" for "apparatus" we come close to Carl Dahlhaus's claim that "the aesthetic presence of individual works will necessarily intervene in any account of the past." Dahlhaus considered this chronological disruption a central epistemological dilemma that led him to proclaim "the special nature of music historiography."[50] But Ernst's project reminds us that "great" works (the object of Dahlhaus's concerns) are not so special in their defiance of linear history after all. Perhaps, then, a music archaeology could forge new paths between and beyond Dahlhaus's binary poles of musical works perceived either as timeless aesthetic utterances or as cultural-historical documents, while also mediating media-archaeological insistence on the *Eigenzeit* of sound objects with their inherent contextual contingencies. Historically discrete media *and* cultural artifacts might jointly be conceived as creating intersecting networks of crisscrossing historical continuities beyond chronological time. Such a perspective would interface the history of musical composition with a wider field of human invention,[51] accounting for objects and processes, media and cultural techniques, men, music, and machines.

Meta-aurality: A History of Listening to Listening

PETER McMURRAY

In 2005 Native American composer Brent Michael Davids premiered a new piece entitled *Tinnitus Quartet*. Davids suffers from tinnitus; the piece is structured around a persistent high A that Davids hears in his right ear.

48. Ernst, *Digital Memory*, 175. On media carrying out their own archaeology, see also Peter McMurray's contribution to this colloquy.

49. Ernst, *Digital Memory*, 57. See also Ernst, *Sonic Time Machines*, 93–95.

50. Dahlhaus, *Foundations of Music History*, 3.

51. On media archaeology's affinities with organology, for instance, see Roger Moseley's contribution to this colloquy. In his most recent work Ernst himself has sounded out different resonances between musical practices and media-archaeological alternatives to historiography, on the basis of what he calls the inherent sonicity of media: Ernst, *Im Medium erklingt die Zeit*, esp. 211–19.

Davids's piece fits into a long tradition of music by composers suffering from tinnitus. Most famously, Beethoven complained as early as 1800 of a "ringing and buzzing in my ears."[52] Robert Schumann also described sounds he heard in his ears as "ceaseless ringing and musical sounds" and "the most terrifying sensation and a ceaselessly sounding, tormenting music."[53] In his later years, Schumann, like Davids, apparently heard the note A persistently.[54] And in 1876 Bedřich Smetana would foreshadow Davids's quartet by attempting to approximate the effects of tinnitus in his string quartet "From My Life." He explained, "The long insistent note in my finale [of the first movement] . . . is the fateful ringing in my ears of the high-pitched tones which, in 1874, announced the beginning of my deafness."[55] Many scholars are interrogating such issues through neuroscience and disability studies,[56] and all these biographical fragments raise a key question for media theory, too: what does it mean to listen to sounds that seem to be produced by the ear?

The same questions hold relevance for aurality more generally. What does it mean to listen to listening? What is the history of such a practice? How might it be done and what would it reveal? These questions point to a long span of ideas about tinnitus and other ways of listening to listening, as well as an attempt to conceive of a sound-native form of media archaeology—what I call "sonic archaeology." In particular, the human listening apparatus offers a key site for thinking about the possibilities and limitations of archaeology *through* and *by* sound and sound media. I consider such an archaeology here, focusing on two kinds of sounds produced and/or perceived by that apparatus: tinnitus and otoacoustic emissions.

The term "media archaeology," while neither coined nor even used by Friedrich Kittler, is closely associated with his poststructuralist, hardware-centric approach to media history.[57] But the concept of media archaeology is hardly self-elucidating. In the spirit of Wittgenstein, we might begin by interrogating it in terms of language: what is the relationship between the two terms "media" and "archaeology"? At first glance it would seem to be an archaeology *of* media—in the same way that one might write an archaeology of prisons, mental hospitals, or sexuality, like Foucault, or, more directly relevant, of the gramophone or the alphabet, like Kittler, or of "noise," like

52. Beethoven, *Beethoven's Letters*, 1:32.

53. Quoted in Sams, "Schumann's Hand Injury," 1158 ("das ewige Klingen und Musizieren"; "dem schrecklichsten Sinnen und ewig singender quälender Musik"). Translations in this essay are mine unless otherwise indicated.

54. See Sacks, *Musicophilia*, 51.

55. Quoted in Keller, *Chamber Music*, 451.

56. See, for example, Straus, *Extraordinary Measures*; Cheng, *Just Vibrations*; Bakan, "'Don't Go Changing'"; Mills, *On the Phone*; and Arbib, *Language, Music, and the Brain*.

57. See Parikka, *What Is Media Archaeology?*, 67–70.

Bernhard Siegert.[58] But the term could just as well denote archaeology *by* media, following Wolfgang Ernst's assertion that *media themselves* can be the archaeologists—that is, the operations and materiality of a given medium can themselves demonstrate the historical ruptures and surprising continuities of that medium and its usage. Ernst's paragon, the monochord, performs its own archaeology by demonstrating the basic physics of vibrating strings and the overtone series, whether played today or in the time of Pythagoras.[59]

Following Ernst's lead we might turn to the ear and the human auditory system as a fleshy medium that can similarly serve not only as the site or object of archaeology but as the actor of archaeology itself. This possibility is already suggested in Mara Mills's history of cochlear implants.[60] Cochlear implants allow transduction to take place outside the ear, such that electrical signals are sent directly to the brain, resulting in a kind of "earless hearing." Tinnitus and otoacoustic emissions, while rooted in the auditory system itself, similarly challenge a notion of audition in which hearing is simply hearing—and nothing else. Instead, both tinnitus and otoacoustic emissions raise the issue of an ear that *produces* sound, whether psychoacoustically (as in most cases of tinnitus) or physiologically (as in the case of otoacoustic emissions), which in turn challenges us to understand hearing as some kind of media process of receiving, processing, and transmitting sensory data.

An Archaeology of/by/in the Ear: Tinnitus

The earliest accounts of ears that sound are to be found in Egyptian texts from the sixteenth century BCE dealing with "bewitched ear[s]."[61] The library of the seventh-century-BCE Assyrian king Ashurbanipal at Nineveh, now held in the British Library, includes hundreds of cuneiform medical tablets. Many of these are devoted to remedies for diseases of the ears, especially a problem widely considered to be tinnitus: "If the hand of a ghost seizes on a man, and his ears sing . . ." The tablets then suggest a variety of treatments, ranging from making charms and stuffing them in the ears to fumigating the ear with various chemicals "by means of fire."[62] Three different kinds of tinnitus appear in these tablets: ears that "sing," that "whisper," and that "speak," which may correspond to ringing tinnitus, hissing tinnitus, and perhaps auditory hallucinations.[63] Significantly, the cause of these ailments

58. Foucault, *Birth of the Clinic* and *Archaeology of Knowledge*; Kittler, *Gramophone, Film, Typewriter* and *Musik und Mathematik*, vol. 1; Siegert, "Cacography or Communication?"

59. Ernst, *Im Medium erklingt die Zeit.*

60. Mills, "Do Signals Have Politics?"

61. See Stephens, "Treatment of Tinnitus," 963.

62. See Thompson, "Assyrian Prescriptions," 1–6.

63. See Stephens, "Treatment of Tinnitus," 963–64.

is ascribed to the hand of a ghost, highlighting the (often) nonvisible etiology of tinnitus.

Greek and Latin medical writers, including Hippocrates and Galen, identified tinnitus—which is derived from the Latin "tinnīre," meaning "to ring"—as an explicitly medical disorder. In one of the more extended commentaries on the subject, Aulus Cornelius Celsus (first century CE) crucially introduces the ailment as "ubi aures intra se ipsas sonant"—"when the ears resound within themselves."[64] The ears have a complex, multifunctional role here as both the agent/subject of the sounding or ringing ear ("aures sonant") and also as the site of the action ("intra se ipsas"). The combination of the verb "sonant" (which can be intransitive or transitive) and the emphatic "ipsas" suggests an almost reflexive sense as well: the ears cause [the space] within the ears—that is, the ears themselves—to resonate. Sound of/by/in the ear: the ringing of tinnitus sets into motion a sonic archaeology with the ear as archaeologist.[65]

Not long after Celsus's death the Roman emperor Titus came to power after besieging Jerusalem and destroying the Second Temple. According to an account in the Babylonian Talmud, not present in any other Roman-era sources, Titus's ears suffered from tinnitus as a form of divine punishment:

> A gnat entered his nostril and pecked at his brain for seven years. One day Titus was passing by a blacksmith. He heard the noise of the sledgehammer and the gnat became silent. Titus thus said: "Here is the remedy." Every day he brought a blacksmith to bang in his presence. . . . For thirty days this worked fine but then the gnat became accustomed [to the banging] and it resumed pecking.[66]

Neurologist Bernard Dan describes this episode, though probably not historically factual, as "remarkably modern," especially in its recommended treatment, which is "strikingly similar to current approaches" in sound therapy.[67] In short, the blacksmith solution uses a different sound to mask the hum of tinnitus in much the same way as white noise or ambient recordings are used today.

Many other accounts of tinnitus appear over the centuries, both as medical writing and as more general historical description. But by the fifth century we already see a nascent awareness that such a malady exists with different forms of sonic expression, emanating from the ear (or the auditory system

64. Celsus, *De medicina*, VI.7.8, 243.

65. Following these historical sources, I call the site/focus of this archaeology "the ear." As mentioned above, most tinnitus is a psychoacoustic phenomenon associated with the brain's auditory cortices. Tinnitus's connection to the physical ear remains important, however, since damage to the inner ear hair cells seems to be one of the most salient causes of the condition. For more on the location of tinnitus, see Schlee et al., "Mapping Cortical Hubs."

66. Quoted in Dan, "Titus's Tinnitus," 211.

67. Ibid., 211–13.

more broadly) and causing it to sound, and that masking therapies might alleviate it. The following millennium and a half of Western medical science would mostly only refine these ideas.

An Archaeology of/by/in the Ear: Otoacoustic Emissions

Jumping ahead to the twentieth century, we find other instances of otic archaeology, often made audible through the confluence of listening composers and new developments in science. One such encounter that has become particularly iconic is John Cage's 1951 experience in an anechoic chamber at Harvard's Psycho-Acoustic Laboratory, built by the US military during World War II. He later recounted that he "heard two sounds, one high and one low," which were then described to him as his "nervous system in operation" and his "blood in circulation."[68] Whether or not Cage was experiencing tinnitus intensified by anechoic space, as some have suggested,[69] he draws attention to the possibility of listening to audible, physical emissions from the body.

Three years before Cage's anechoic experience Thomas Gold predicted a strange, and related, phenomenon while working at the University of Cambridge. He too worked in a laboratory devoted to wartime communication, and in 1948 authored an article fittingly titled "Hearing," in which he explored "the physical basis of the action of the cochlea."[70] In particular he argued that "the assumption of a 'passive' cochlea, where elements are brought into mechanical oscillation solely by means of the incident sound, is not tenable."[71] In other words, the sheer force of a sound wave was not enough to generate the electromechanical activity that had been documented in the ear; the cochlea itself must be "active" in order to account for the ear's fine-tuned discrimination of frequency and loudness. He proposed a "regeneration hypothesis" by which the cochlea has "microphonic potential"—in other words, the inner ear functioned as, among other things, an amplifier.[72]

Gold's hypothesis was either ignored or rejected by the psychoacoustics community (including those working in Harvard's anechoic chambers), but was picked up thirty years later by physicist David Kemp. Kemp was able to record the sounds generated by the cochlear amplifier by placing a microphone in the ear canal. In short, sounds enter the cochlea and set into motion a kind of reverse echo, which is amplified electromechanically by the outer hair cells of the cochlea in vibration with incoming stimuli, and then sent back through the ear canal as a feedback mechanism a few milliseconds later. Kemp called these feedback sounds "otoacoustic emissions."

68. Cage, "Experimental Music," 8.
69. See Revill, *Roaring Silence*, 153–54, and Prochnik, *In Pursuit of Silence*, 182–83.
70. Gold, "Hearing."
71. Ibid., 492.
72. Ibid.

Kemp's critical methodology was listening to the ear, further refining a practice that had emerged with the study of tinnitus:

> A number of people at that time had claimed to have been able to record tinnitus with a microphone put to the ear with tinnitus. One had found tones and another clicks. So *the idea of listening to an ear with a microphone* was not new even though the consensus was then (as it is today) that most tinnitus was not due to a physical vibration in the ear. But the idea of a sound coming out of a normal ear was indeed, novel. . . .
>
> . . . I realized if there were physical resonances occurring inside the cochlea it should be possible to detect these from outside, acoustically in the ear canal, because of the way the middle ear links the cochlea and the ear drum.[73]

Kemp points to the importance of tinnitus in setting the stage for his own experimental methodologies, but also offers a broader insight about the multidirectionality of the ear—a comment that resonates with Celsus's observation of the ear sounding (itself) within itself. The physiology of the ear means that sound can travel just as well out of the ear as into it, and thus that any sound entering the ear would in turn produce an echo that leaves the inner ear.

As they continued listening to and recording the sound of the ear listening, Kemp and his colleagues came to an even more radical conclusion: much like tinnitus, there was more than one type of otoacoustic emission, including some types that occurred spontaneously without any external stimulus. And in a remarkable double-feedback loop, somewhere between 6 and 12 percent of people who think they suffer from tinnitus in fact suffer from otoacoustic emissions that they themselves can hear.[74]

Composing the Ear

These two brief historical glimpses of tinnitus and otoacoustic emissions offer preliminary steps toward a sonic archaeology of human hearing. While it appears that the former has more to do with the nervous system and the latter with the ear, both phenomena illustrate the complex ways in which audition may be auditioned. Again, composers and sound artists—some of the most famous sufferers of such conditions—have repeatedly found ways to employ such extended listening techniques in their work. Danish sound artist Jacob Kirkegaard, for instance, has composed multiple pieces and installations from spontaneous otoacoustic emissions, including *Earside Out* (2015). These compositions pose a complex phenomenological question:

73. Douglas L. Beck, "Otoacoustic Emissions, Tinnitus, Distortion Product OAEs, and Transient OAEs: Interview with David Kemp, PhD," American Academy of Audiology website, Interviews, January 6, 2009, accessed August 31, 2015, http://www.audiology.org/news/otoacoustic-emissions-tinnitus-distortion-product-oaes-and-transient-oaes-interview-david-kemp (my emphasis).

74. See Norton, Schmidt, and Stover, "Tinnitus and Otoacoustic Emissions."

what does it mean to listen to such remediations of listening? *Earside Out* can be understood as an experiment in listening to listening to listening. It is a powerful media recursion that not only reproduces the sounds of the ear but allows them to be edited, recombined, and listened to again.

Flattening as Cultural Technique: Epistemic and Aesthetic Functions of Inscribed Surfaces

SYBILLE KRÄMER

Time Axis Manipulation

The irreversibility of time is a strict invisible hand.[75] For all things living, all things aging and perishing, the direction of time is irreversible. This is particularly noticeable in human activities whose products are fluid acoustical vibrations—that is, speech and music. No sooner is the sound of language or music emitted than it disappears. The existence of tones consists in their disappearance. It was Friedrich Kittler's ingenious insight that technical media open up the possibility of time axis manipulation, in which the order of time becomes a variable.[76] The spatialization of temporal processes in symbolic configurations makes their order and concatenation not only repeatable but also manipulable and reversible.[77] Thus it is unsurprising that the invention of written notation marks a watershed in both music and language. As is well known, the scriptualization of ephemeral sounding material brought forth new aesthetic forms, modalities of archiving, and distribution, as well as new means of compositional creativity.

The specific dimension of musical notation is usually interpreted as transforming the fluid sequence of sounds into a fixed graphic structure whose elementary direction is linear. The spatializing techniques of notation are, however, more complex. Scripts use two-dimensionality.[78] Think of written-down calculations, of headings and footnotes, of the direction of lines from top to bottom; think also of crossword puzzles. Kittler's idea of time axis reversal is not far off: when uttered as an acoustic succession of sounds, a sentence cannot (or can scarcely) be reversed, whereas inverting the succession of letters in a written sentence is perfectly possible. Yet the operative potential of inscriptions is not limited to inventions of notations. It also includes all writing-down systems, or *Aufschreibesysteme*,[79] arising

75. Thanks to Alexander Rehding for translating this essay and for his insightful comments on it.

76. Kittler, *Draculas Vermächtnis*, 182. See also Krämer, "Cultural Techniques."

77. See Kittler, *Literature, Media, Information Systems*, 130–46.

78. See Harris, "On Redefining Linguistics," 39.

79. See Kittler, *Aufschreibesysteme.*

instrumental technologies and vocal techniques, but also from the Hoffmannian poetry and criticism that discursively stored and transmitted its nondiscursive qualities at the onset of the nineteenth century. As "poetry raised to a higher power," in Robert Schumann's formulation,[127] music became conceivable by way of the very alphabetic symbols its meaning exponentially exceeded.

In the twentieth century the advent of historically informed performance staged the temporality of sonic enactment precisely at the post-phonographic juncture when the practice of making music turned from an unmarked contemporary phenomenon into a relic of an unsalvageable past. Again, new aesthetic possibilities were made imaginable by the limitations as well as the capacities of a technology that promised to realize dreams of musical time- and space-travel. Today, the Romantic rhetoric of autonomy, ephemerality, and fugitivity has migrated one stage further, from representations and enactments of sonic experience to the medium of sound itself. As Brian Kane notes, a stratum of scholarship within sound studies has stitched together the shopworn remnants of Romantic aesthetics in order to ground ontological fantasies of the ineffable.[128] Oscillating between technical detachment and transcendental rapture, Ernst's prose ultimately underwrites the same enterprise.

To imagine alternatives in the terms expounded by Rehding we might deploy media archaeology not as a totalizing method but as a set of cultural techniques that construct the means by which music's temporality becomes apprehensible.[129] At the same time, we might turn back to music as evidence of how sonic transience can be cultivated and sustained. If media archaeology encourages us to listen afresh to familiar musical patterns, then the rehearsal of such patterns reveals in turn how music never ceases to create the temporal domains it occupies. From this perspective, all music constantly aspires to the condition of a *partimento* insofar as it responds to the teasing out of melodic and discursive counterpoints that are at once discovered and invented, retrieved and generated, old and new.

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127. Quoted in Daverio, *Robert Schumann*, 43. On the literary, poetic, pedagogical, and bureaucratic techniques by which such operations were performed in early nineteenth-century Germany, see Kittler, *Discourse Networks*, 3–173.

128. Kane, "Sound Studies."

129. See Siegert, *Cultural Techniques*; Winthrop-Young, "Discourse, Media, Cultural Techniques"; and Rehding's contribution to this colloquy.

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