# The Critique of Technology in Electronic Music

Thomas W. Patteson

"Composition is a wonderful method for discovering not-yet-appointed criteria." – Herbert Brün[1]

We tend to assume that to use an instrument means to have a preformed mental image of the work that is to be done with it. But instruments can also be the source of unpredictability, chance, and play—not as failures but as conscious desiderata. It is this inversion of the conventional model of instrumentality that I seek to investigate in this paper, pursuing it in the particular context of electronic and experimental practices in twentieth-century music.

In our everyday understanding, to use a tool means to have a particular action or outcome in mind, a "final cause" in the Aristotelian sense, for the sake of which the tool is employed. Karl Marx argued that humanity was distinguished above other animals by its ability to conceive of products in advance of the act of labor; his description is echoed in many attempts to differentiate between notated "composition" and the supposedly formless improvisations of nonliterate musical cultures:

> We have to consider labour in a form peculiar to the human species. A spider carries on operations resembling those of a weaver; and many a human architect is put to shame by the skill with which a bee constructs her cell. But what from the very first distinguishes the most incompetent architect from the best of bees, is that the architect has built a cell in his head before he constructs it in wax. The labour process ends in the creation of something which, when the process began, already existed in the worker's imagination, already existed in an ideal form.[2]

Marx's idea of the relationship between the real and the ideal in the labor process, which he applied to the example of the architect, is generally assumed to cover all acts of human creation. On

---

This is an amended version of a paper circulated as part of the panel discussion on "Critical Organology," chaired by Emily Dolan, which took place at the annual meeting of the American Musicological Society in Pittsburgh on November 7, 2013.

[1] "Interview with Herbert Brün," in Curtis Roads, ed., *Composers and the Computer* (Los Altos, CA: William Kaufmann, 1985), 8

[2] Karl Marx, quoted in Ernst Fischer, *The Necessity of Art*, trans. Anna Bostock (London: Verso, 2010), 26-27. One might wonder, how *does* the spider or the bee carry out its work? How does it complete the job without the internal vision that Marx (rightly or wrongly) denies it? Is it aware only of each individual step in the labor process, through which it is guided by instinct like a sleepwalker?

the one hand, there is the idea; on the other, the material product, and what turns on into the other is the literal realization effected by human labor. What is left out of this equation is, of course, the instrument. Following from the logic of this model, the role of the instrument in the production process would be simply to minimize the required labor and allow the product to resemble its ideal form in the mind of the creator with the utmost fidelity.

This is the way we tend to think about musical instruments, as well. Whatever irrational allure instruments still possess in the disenchanted world of late modernity, they are first and foremost tools for work. This is all the more clear in the history of "electronic music," which, as it is typically told, is essentially the quest for the perfect instrument—perfect in the sense of allowing for the realization of that preconceived, ideal work that, to paraphrase Marx, "already existed in the composer's imagination." Technological innovation in twentieth-century music has been viewed primarily as the progress toward an ever greater degree of compositional control.

Perhaps the paragon of this ideal is Edgard Varèse. In the early twentieth century, he wrote: "I dream of instruments obedient to my thought and which with their contribution of a whole new world of unsuspected sounds, will lend themselves to the exigencies of my inner rhythm."[3] Although he was a musical godfather to many of the post-World-War-II pioneers of "experimental music," Varèse notably disavowed the label for his own work, stating, "My experimenting is done before I make the music. Afterwards, it is the listener who must experiment."[4] Following Varèse's lead, mid-century electronic musicians celebrated the ability to reckon their work in terms of precise acoustic measurements: Herz and milliseconds instead of the cumbersome conventions of traditional notation. Karlheinz Stockhausen's preference for the humble sine-wave generator lay in the absolute

[3] "The Liberation of Sound," *Perspectives of New Music* 5/1 (1966), 11.

[4] Quoted in Thom Holmes, *Electronic and Experimental Music: Technology, Music, and Culture*, 3rd ed. (New York: Routledge, 2008), 342.

precision the device afforded composers who, like Stockhausen, "want[s] to know what's inside the sounds [he's] working with."[5] (It was this rationalist discipline that provoked Theodor Adorno to denounce what he saw as music's "pseudomorphosis into science."[6]) The emergence of "computer music" in the third quarter of the century is typically seen as the culmination of this quest for instrumental perfection. Indeed, the appearance of the first book-length histories of electronic music around 1970 coincided with the establishment of the computer as a musical instrument. In Hegel's classic phrase, "The owl of Minerva flies only at dusk": the history of electronic music could only be written once its putative telos was finally in sight.[7]

This historical and conceptual model—what we might call *high modernist instrumentality*—so dominates our thinking that it has become the basis for the entire historiography of electronic music. The progression from magnetic tape to modular synthesizer to digital computer is a sort of technological *Gradus ad Parnussum* ascending to an ideal state of mastery, the point at which the instrument becomes the transparent medium linking idea and work. In this paper, I argue that high modernist instrumentality is in fact only one particular vision of the role of technological innovation in contemporary music, and that alternate models offer both new images of music-making and new ways of thinking about instrumentality as such. These alternative instrumentalities can be found at every step of the technological development of music in the twentieth century. For the purposes of this essay, I'll focus on the three exemplary technological stages: magnetic tape, the analog modular synthesizer, and the early microcomputer.

---

[5] Quoted in Maria Morawska-Büngeler, *Schwingende Elektronen: Eine Dokumentation über das Studio für Elektronischen Musik des Westdeutschen Rundfunks in Köln, 1951-1986* (Cologne: P. J. Tonger, 1988), 33.

[6] "The Aging of the New Music" (1955), in Richard Leppert, ed., *Essays on Music* (Berkeley: University of California Press, 2002), 193.

[7] See, for example, Herbert Russcol, *The Liberation of Sound: An Introduction to Electronic Music* (Englewood Cliffs, NJ: Prentice-Hall, 1972), 180-202.

But first, a little background. In an interview in 1980, John Cage described what he called "music of contingency," which was characterized by "a rupture between cause and effect, so that the causes that are introduced don't necessarily produce effects":

> One piece, *Inlets* [1977], uses conch shells, for example; if instead of blowing a conch shell, you fill it with water and tip it, it will sometimes gurgle and sometimes not. You have no control over it. Even if you try very hard to control it, it gurgles when it wishes to...when it's ready to. Sometimes if you rehearse with it and think that you've got it down pat, you'll discover as I do, I'm sure, that it foxes you and gurgles when it chooses.[8]

While Cage's notion of "indeterminacy with regard to performance" typically meant that the performer is called on to interpret forms of notation that admit multiple readings, here indeterminacy seems to reside in the instrument itself. The composer or performer's actions may be perfectly systematic, but the mappings that relate those actions to particular sonic results are scrambled. It is significant that Cage introduces a new term—"contingency"—to describe the loosened relationship between cause and effect in pieces such as *Inlet*. This describes a particular, non-linear relationship between the "input" of the performer's actions and the "output" of the instrument's sound production. It is neither determinate nor indeterminate, but something in between.

**"Indeterminacy with regard to composition"—"Indeterminacy with regard to performance"—"Music of contingency"**
**[Composer] [Performer] [Instrument]**

In the case of *Inlets*, the instrument is an *objet trouvé* whose very foreignness prevents the performer from attaining mastery over it. But the idea of using instruments as sources of indeterminacy emerged much earlier. It was Cage who first used electric technologies as musical chaos generators, in pieces such as *Imaginary Landscapes No. 4* (1951) for twelve radios, where tuning and volume controls are precisely notated, but the actual sounds are unpredictable. This basic, generative disjunction between plan and outcome, mediated by the instrument, would be the model

[8] Quoted in David Cope, *New Directions in* Music, 7th ed. (Long Grove, IL: Waveland Press), 100.

for much work to come. The following is a selective sampling of the incredibly diverse array of efforts in this direction.[9]

In Pauline Oliveros' piece *I of IV* (1966), the composer assembled a network of tape machines and oscillators to create an electronic soundscape in real time. The oscillators generate 12 tones corresponding to the 12 pitch classes of the equal-tempered scale; 11 are superaudible sine waves (above the range of human hearing), while one is a square wave tuned below one Herz, thus inaudible. Audible sounds are created by combination tones among the high frequencies, while everything is pulse-modulated by the low tone as well. Tape delays of up to eight seconds are created by separating two tape machines by five feet. In this model of instrumentality, the composer stipulates quite exactly the initial parameters of the piece, such as the frequencies of the electronic oscillators and the length of the tape delay, but the resulting sonic output is an unforeseeable. Between compositional design and sonic output, the technological apparatus intervenes as a "black box" whose workings are theoretically explicable but phenomenologically excessive.[10] As Alvin Lucier explains, "The trick is to design the configuration in such a way that the delays are not heard as periodic. You have to be able to forget them."[11]

A similar use of electronic technology was pursued by the German composer Roland Kayn. Beginning around 1970, Kayn's compositional work was concentrated in a unique interface with the modular synthesis system installed at the Institute of Sonology in Utrecht, Holland. Kayn would

---

[9] Probably the most well-known advocates of indeterminate electronics were the American composers who in 1966 founded a collective called the Sonic Arts Union: Robert Ashley, David Behrman, Alvin Lucier, and Gordon Mumma. Though each of these composers pursued a distinctive path, they all shared an interest in making music in which technology, sound, and performative action were engaged in a complex interplay of cause and effect, reaction and feedback. Behrman and Mumma, in particular, built their own circuits in order to circumvent the prepackaged modalities of consumer-grade electronic devices.

[10] The term "black box" is used in circuit theory and cybernetics to refer to devices or systems whose input and output can be perceived but whose internal functions are obscured or unknown.

[11] Alvin Lucier, *Music 109: Notes on Experimental Music* (Middletown, CT: Wesleyan University Press, 2012), 107.

prepare by setting up an elaborate system of interconnections between the various modules, which included oscillators, filters, envelope generators, logic circuits, and a "variable function generator," which was essentially a sequencer that could store and discharge series of control voltages. The complexity of this initial setup, and the nonlinear relationships established by electroacoustic feedback loops, meant that the sonic output of the system was unpredictable on the basis of its initial state. Kayn relinquishes compositional agency and becomes the steward of a process that is beyond his control: "The composer is entirely divested of his original function. He can merely decide whether to intervene, guide, or direct, or whether he is prepared to accept what emerges as an auto-generative procedure."[12]

Even the computer, that paragon of musical control, has been explored as a means of improvisation and play. In the late 1970s a group of musicians and personal computer enthusiasts formed a collective called the League of Automatic Music Composers. The League and its spinoff group, The Hub, produced a fusion of computer music and free jazz, wiring their consoles together to produce anarchic networks of sounding digits. The computer's ability to treat sound as information allowed new forms of interaction: instead of responding sequentially to each other's musical gestures, the members could actually collaborate in real time. For example, one member might generate a rhythmic pattern whose impulses would be "voiced" by the pitch information provided by another member working at his own console, with all information being processed in real time by a central computer hub. The League's use of computers in improvisation was taken up by the trombonist and jazz musician George Lewis, who saw the computer as the ideal means of exploring the freely evolving textures typical of his colleagues in the Chicago-based Association for

[12] Roland Kayn, "Soziologische-, technologische- und aesthetische Aspekte akustischer Innovation am Beispiel eigener Werke," http://www.kayn.nl/publications.html (accessed 20 December 2011). See also my essay "The Time of Roland Kayn's Cybernetic Music," in *Sonic Acts XIV: Travelling Time*, ed. Arie Altena (Amsterdam: Sonic Acts Press, 2012), 47-66.

the Advancement of Creative Musicians.[13] For Lewis, there was no contradiction between the apparently servile computer and the liberatory spirit of the "Afrological" improvisatory impulse. In Lewis' work *Voyager*, two human musicians play along with a computer-controlled "virtual improvising orchestra" programmed to "listen" to the players' music and respond with a continuously changing repertoire of stylistic elements. The result is what Lewis describes as "multiple parallel streams of music generation, emanating from both the computers and the humans—a nonhierarchical, improvisational, subject-subject model of discourse, rather than a stimulus-response setup."[14] The computer is used not because it is perfectly obedient to the composer's intentions, but rather because it is capable of transcending any possibilities he might conjure up. Rather than serving as the means of realizing a preconceived music in the mind of the composer, instruments figure here as probes to discover of new and otherwise inconceivable musical (sonic, formal, social) phenomena.

In these works, the electronic instrumentarium becomes the forum for an approach to composition at once rationalistic and playful. The unexpected arises not from deliberate design, but from the sheer inscrutability of the technical and social processes that the composer has arranged. The instrument appears as an organism, rather than machine: it is not neutral and passive, but responsive and perhaps even capable of thought. Lucier says Oliveros' *I of IV* "sounds like a living organism," Kayn suggests his creations attest to an emergent artificial intelligence, and Lewis invokes African folk wisdom about the sentience of musical instruments.

In closing, I'd like to step back and consider the broader historical and conceptual field in which the compositional tendencies I've described have evolved. These challenges to modernist

---

[13] On this connection, see Curtis Roads, "Improvisation with George Lewis," in Roads, 75-87.

[14] George E. Lewis, "Too Many Notes: Computers, Complexity and Culture in *Voyager*," *Leonardo Music Journal* 10 (2000), 34.

instrumentality both reflect and propagate the broader critique of techno-scientific mastery that emerged in the late twentieth century. What they represent is not a turn away from technology toward a reactionary naturalism, but rather a critique of technology within the medium of technology itself.[15] It was certainly no coincidence that the first challenges to high-modernist instrumentality in the musical activities of the 1960s and '70s were accompanied by widespread social upheaval and a loss of faith in technocratic governance, unlimited growth, and unchecked exploitation of nature. While many such trends took the form of a dubiously pastoralist critique of technology, other views suggested that the problem was not so much technology itself as the institutional matrix in which it was embedded. In his 1973 classic *Small Is Beautiful*, British economist E. F. Schumacher decried the "idolatry of gigantism" in contemporary society, and declared that "we need methods and equipment which are cheap enough so that they are accessible to virtually everyone; suitable for small-scale application; and compatible with man's creativity."[16] Sounding a similar note, philosopher and social critic Ivan Illich described a scaled-down vision of humanized technology that he called "tools for conviviality," tools that give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her own vision."[17]

If we accept Christopher Small's assertion that "a composer's attitude to his sound materials in any culture is a fair indicator of that culture's attitude to nature"—and to "sound materials" we may add instruments and all the other accoutrements of music-making—we are led to some significant

---

[15] A yet more radical example may be found in *The Roachville Project*, a 1967 prose piece by Barney Childs, elides the categories of instrument and composition. The "score" stipulates that 4 to 10 performers, provided with a large amount of sound-producing material ("wires, pipes, blocks, tubes, containers, bits and pieces of musical instruments, junk, etc.") work together to construct a single "music instrument" of their own design. Any discussion about the work, or testing of the materials' acoustic properties, must be done "very quietly." Once the instrument is built, the performers bring the activity to a close by improvising music on it for an agreed-upon length of time. See Cope, 100.

[16] E. F. Schumacher, *Small is Beautiful: Economics as if People Mattered. 25 Years Later with Commentaries* (Point Roberts, WA: Hartley & Marks, 1999).

[17] Ivan Illich, *Tools for Conviviality* (New York: Harper & Row, 1973), 22.

conclusions.[18] The music I've discussed in this paper suggests an alternative to the antagonistic relationship between humanity and nature that has characterized Euro-American civilization since the scientific revolution. In place of the "commanding of nature," as Small characterizes the attitude of the classical tradition (and this goes for high modernist instrumentality as well), these new tendencies offer models such as exchange, discourse, inquiry, and play. Instruments, no longer the docile tools of compositional mastery, now suggest a world in which machines relieve us not only of the necessity of labor, but also of something perhaps more burdensome yet: the self-assurance of our own aesthetic tastes.

[18] Cristopher Small, *Music, Society, Education* (New York: Schirmer, 1977), 83.