ELECTROACOUSTIC MUSIC

Analytical Perspectives

Thomas Licata

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Edited by
Thomas Licata

Foreword by Jean-Claude Risset

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Karlheinz Stockhausen, *Texte zur Musik 3* (1971): 79–84. (This book and all Stockhausen scores, CDs and books about Stockhausen may be ordered directly from the Stockhausen-Verlag, 51515 Kurten, Germany).

Emilio Vedova, *Intolleranza '60, n. 2 (a Luigi Nono)*, 1960.

Risset's manuscript of his PLF4 Fortran Program in Chapter 7 is used by permission of Jean-Claude Risset.

for my parents

Margot and Vincent

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Foreword

Jean-Claude Risset

This book on the analysis of electroacoustic music is a timely and significant one. Electroacoustic music blossomed in the second half of the twentieth century. Not only did it expand instrumental music to a wider range of sound material, but it also opened a new sonic art form—another branch of music, as different from instrumental music as cinema is from theater.

This new music has been little discussed in writing, in part because much of electroacoustic music does away with the score, a document that had heretofore seemed essential. The lack of an objective representation makes it difficult to study these works. This has resulted in few textbooks about electroacoustic music and even fewer analyses of electroacoustic works. The present book purports to fill this gap and to shed light on some important works of this medium.

I wish to provide some historical background concerning electroacoustic music. Around 1875, two inventions brought a considerable change to our relationship with sound: the gramophone and the telephone. The gramophone, invented by Thomas Edison, engraved sound, which allowed its replication in the absence of the vibrating object that had produced it. From this point on, one could no longer say "verba volent, scripta manent" (words fly away, writings remain with us): recording provides a durable trace of the sound, enabling one to scrutinize it as an object and to modify it in novel ways—for instance, to play it in reverse. The telephone, invented by Alexander Graham Bell, transformed sound into electrical vibrations that could be transported on wires and converted back into sound. The composer Hugues Dufourt has termed this an "electric revolution": the elaboration of sound can benefit from the resources of electric technology.

Initially, these new possibilities were used to transport and reproduce sound and music rather than to produce new sounds and new music. However, at the turn of the century, Thaddeus Cahill built the "dynamophone"—an electrical machine that produced musical sounds with electric dynamos (it was also called the "telharmonium"). Being in the form of electricity, the musical signal could be carried on telephone lines and sent remotely, a concept later evoked by

Stockhausen in his piece *Telemusik* (a work analyzed in this book). The success of Cahill's machine, however great, was short-lived, yet it excited the imagination of Varèse, who insisted all his life that science and technology were to provide new resources for music.

In the first half of the twentieth century, some "electronic instruments" appeared, for instance, the Theremin and the Martenot. These were mostly used to mimic existing acoustic instruments such as the violin. However, during the 1930s there were a few attempts to experiment with recording and electricity in music by such composers as Milhaud, Hindemith, Toch, Varèse, and McLaren. Stokowski called for the realization of scores "directly in tone, not on paper." John Cage's *Imaginary Landscape No. 1* (1939), in all likelihood, is the first musical work that exists not as a score but as a sound recording.

These concepts became especially practical after 1948. In this year, Pierre Schaeffer invented *musique concrète*—recording sounds and then modifying and assembling them to realize the musical work as a concrete recording rather than an abstract score. In 1950, Schaeffer and Pierre Henry composed *Symphonie pour un homme seul*—a single man monitoring the recording at the console. Schaeffer and Henry, as well as Luc Ferrari, François Bayle, and Beatriz Ferreyra, composed "by ear," experimenting and critically listening to sounds and their combinations.

In contradiction, the early practitioners of "electronic music," following Herbert Eimert, Karlheinz Stockhausen, and Gottfried Michael Koenig in Cologne around 1950, were concerned with creating precise, sonic realizations of complex scores, formally elaborated in advance, in the spirit of the serial methods of composition. They insisted on using only electronically produced sounds, whose physical parameters could be precisely controlled. Milton Babbitt had similar preoccupations when he realized such works as his *Ensembles for Synthesizer* on the RCA machine, a precursor of the synthesizers that later became popular.

One of the first major works that combined both electronic and "concrete" sounds was Stockhausen's *Gesang der Jünglinge*. Analyzed in this book by Pascal Decroupet and Elena Ungeheuer, this work was very successful and highly influential. Luigi Nono, also represented in this book, likewise adopted this syncretic approach, as well as associated electronic sounds with instruments (as did Luciano Berio, Mario Davidovsky, Milton Babbitt, and number of others).

In 1957, Max Mathews implemented the first digital computer synthesis of sound at Bell Laboratories. The computer in itself is a neutral medium, since it permits the implementation of a great variety of processes with unprecedented precision and reproducibility. Indeed, nearly all electroacoustic music is now produced digitally.

I had myself begun composing with instruments, and I hadn't been attracted to either *musique concrète* or "electronic music." It seemed to me that *musique concrète* afforded a great variety of sonic material but that the ways to process or assemble the sounds were rudimentary with respect to their richness, which made

it hard to avoid an aesthetics of "collage." "Electronic music" offered a more ductile material. The sounds could be better controlled in their parameters, but I found them dull, lacking life, richness, and identity. I was intrigued when I learned of the new digital possibilities—perhaps they could reconcile richness and control. In the 1960s, I had the good fortune to collaborate with Max Mathews (and, indirectly, John Chowning) in developing the musical possibilities of sound synthesis. Indeed, the sonic resources of the computer had to be conquered, and this exploration provided valuable insight to the perception of musical sounds—one had to find ways to produce interesting sounds, so the development of specific knowledge and expertise was needed. Fortunately, the computer permits the implementation of a large variety of processes as well as the storing of thorough and accurate records of them, making it easy to communicate sonic descriptions, recipes, and sound catalogs.

The categories of "electronic music" and *musique concrète* still exist in the digital domain within two branches: the *synthesis* and *processing* of sound. However, the gap between synthesis and processing can be bridged through such methods as analysis-synthesis. There are still aesthetic arguments between the defenders of "live electronic music" and those who realize "music for tape." A few composers (among them Pierre Boulez) have viewed electroacoustic music as a prolongation of instrumental music, offering a mere extension of the available sound material. According to this conception, electroacoustic music should be performed live in an instrumental fashion. Others insist that music should not remain confined in an instrumental context. Beyond composing solely with ready-made sounds, electroacoustic composition can offer the possibility to compose the sounds themselves. The craft of composition must therefore be liberated from the real-time constraints of performance, resulting in a recording that constitutes the musical work itself—a "cinema for the ear," according to François Bayle. The expression "music for tape" has become somewhat archaic, since sounds today are recorded in digital form (DAT, other format audiotape, compact discs, or any other form of digital memory) rather than on analog tape. In France and Quebec, one often uses the more accurate expression *musique sur support*—"music for the recording medium"—but "music for tape" is still popular and well understood.

Most compositions for tape do not come with a score. The lack of a written document creates great difficulties for the musicologist who insists on carrying out rigorous, "objective" work. One might object that sound recording is an objective trace of the work—in the case of "music for tape," it could almost be said to coincide with the work itself—but it is certainly not a convenient document to consider, no more than Jorge Luis Borges' fictitious maps that coincide with the territories that they represent. Because of this problem, music for tape has been somewhat disregarded by musicology.

In an article for the *Contemporary Music Review*, Marco Stroppa enumerated the difficulties that he confronted in analyzing my piece *Songes*. The lack of a representation analogous to the conventional score prompted Stroppa to renounce the performance of his analysis. Because he found them too gross and

approximate, he dismissed "listening scores": descriptive sketches realized, generally a posteriori, enabling one to follow the piece. As for the technical and operational data, which can give valuable information about works realized with computers, he generally considers them as disheartening and even incomprehensible for nonspecialists, especially since they refer to specific hardware and software that are ephemeral due to the rapid evolution of technology.

These difficulties are real. However, if the software used is structured in a way that provides exploitable archives, the coded traces left by the use of the computer can yield considerable amounts of valuable information for analysis. This is the case for C-synthesis programs such as Csound and Music V. I used the latter in my piece *Songes* (however, Stroppa did not have access to my computer "scores"). Therefore, it proves helpful if the composer makes his or her archives available with proper explanations. To take full advantage of these somewhat cryptic traces, those who undertake the analysis must be enlightened specialists, often composers themselves. This is the case for a number of the analyses presented in this book. For instance, the chapter by Konrad Boehmer describes the precise procedures that Koenig used and explicated in composing his piece *Essay*. In two other chapters, the methods used in computer compositions are discussed and elucidated by the composers themselves: Otto Laske and James Dashow. The chapters on Iannis Xenakis' *Diamorphoses* by Thomas DeLio, Luigi Nono's *Omaggio a Emilio Vedova* by Thomas Licata, and Joji Yuasa's *A Study in White* by Kristian Twombly resort to technical tools that can be great assets for musical analysis, such as sonograms and amplitude graphs, which provide some kind of portrayal or cartography of electroacoustic music.

Apart from the case of early electronic music pieces constructed in a very precise and formal fashion, only a few examples can be cited of earlier analyses of electroacoustic music. Around 1970, François Delalande of GRM-Paris wrote a significant article on the analysis of electroacoustic music, and Enrico Chiarucci produced perceptual ("phenomenological") analyses of works by Stockhausen and Penderecki. As DeLio, Licata, and Twombly do in the present volume, Robert Cogan's *New Images of Musical Sound* used sonograms to portray and analyze several musical works of various times, including electronic and digital works. Insightful analyses have been published by Stanley Haynes, Denis Smalley, Simon Emmerson, Hans Ulrich Humpert, Wolfgang Thies, and Michel Chion. Denis Lorrain's analysis of my piece *Inharmonique* was also a reconstitution, since he provided Music V scores that permitted the replication of certain sections through computer synthesis. This approach was also followed in the computer music synthesis manuals by Charles Dodge and Thomas Jerse and by Richard Boulanger. In a volume edited by Wolfgang Gratzer, *Nähe und Distanz*, the composers themselves, as well as other musicologists, provide analyses of instrumental, electroacoustic, and mixed works. The second volume produced by the Academy of Bourges, entitled *Analysis in Electroacoustic Music*, presents both a few general essays insisting on the importance of this issue as well as some analyses of electroacoustic pieces, with most of them documented by their authors.

The present book is an important contribution to the corpus of music analysis, which one can by no means reduce to a blind and automatic dissection according to a priori principles; each work requires its own approach, which may yield surprises. The detailed study of my own piece *Contours*, by composer Agostino Di Scipio, has been fruitful to me, unveiling certain features that I was unaware of. An insightful analysis participates in the life of the work by revealing unsuspected aspects and novel perspectives, enlightening listeners, and inspiring composers—teaching composition consists largely of analyzing musical works. In the case of electroacoustic music, a proper analysis clearly explicates the technical processes involved and their musical necessity and significance. Thus, the chapters that follow will be helpful to the understanding of electroacoustic music and its raison d'être.

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Introduction

Thomas Licata

Electronic and computer technologies have equipped composers with the means to conceive, realize, and convey their musical ideas in ways never before possible. Indeed, since the inception of the electronic age, the music world has witnessed a veritable flood of extraordinarily diverse creative efforts, at times resulting in music of uncommon richness and diversity. Composers from around the globe have come to recognize the enormous creative potential of these resources, which, even today, continue to stimulate new modes of musical thought.

Over the course of the past fifty years, much has transpired within the realm of electroacoustic music. As the technology has grown increasingly more sophisticated and accessible, composers have embraced an ever-growing multiplicity of compositional approaches. Moreover, a considerable amount has been written about electroacoustic music, with much of it directed toward areas such as sound generation and transformation practices, new technological developments and applications, aesthetics, among others. Of course, these areas of inquiry are extremely important and, for the composer of electroacoustic music, even essential. However, only modest attention has been directed toward the actual analysis of electroacoustic works themselves.

Admittedly, the analysis of electroacoustic music presents unique challenges. In general, no score exists for such compositions. Moreover, as many electroacoustic works employ a full gamut of sound materials, from a pure sine tone to a virtual kaleidoscope of noise, music theory has not yet fully developed the means to confront such a wealth of sound materials. Despite such challenges, music theorists (in collaboration with those in computer science, psychology, acoustics, among other fields) must develop ways to effectively study this music. Invariably, new tools and methods will be created that will enhance our abilities to consider electroacoustic music. However, we must always be mindful of the fact that the importance of any new analytical tool or method lies in what it tells us about a musical work that we could not have gleaned in any other way.

The chapters in this book present detailed analyses of important electroacoustic works while also demonstrating some recent approaches to the analysis of this music. Drawn from music composed for "tape" alone by distinguished American, Asian, and European composers, the compositions under consideration span the mid-1950s to the late 1980s. The authors of these chapters are all distinguished composers and/or theorists who have actively worked in the field of electroacoustic music. The wide-ranging methodologies used throughout the book offer a variety of perspectives on the analysis of electroacoustic music. Whether through some form of existing documentation (composer's sketches and annotations, process scores, graphic notational scores, computer programs, among others) and/or some application of computer technologies (sonograms, amplitude graphs), each author endeavors to elucidate the overall sonic design of the work under investigation.

The works examined in the first three chapters, all written between the mid- and late 1950s, reflect the two prevailing aesthetics of electronic composition during its early years: *musique concrète* (based in Paris and drawn upon recorded sound materials) and "electronic music" (based in Cologne and drawn from synthesized sound materials). In Chapter 1, Pascal Decroupet and Elena Ungeheuer present a collaborative analysis of one of the seminal works of this period, indeed of Western music history, Karlheinz Stockhausen's *Gesang der Jünglinge* (1955/1956). This was one of the first works to integrate prerecorded sound materials (a boy's voice) and synthesized sound materials. Largely based on the examination of the composer's sketches, the authors undertake a comprehensive analysis of this work's rich amalgam of vocal and electronic sound materials as well as the serial and various extended serial procedures used throughout the piece. In Chapter 2, Thomas DeLio presents an analysis of Iannis Xenakis' first electroacoustic work, *Diamorphoses* (1957). Through the use of numerous and revealing sonograms of this work's recorded source materials (bells, airplane noises, and explosions), DeLio offers penetrating insight into the overall development and ultimate synthesis of these contrasting sounds, thereby revealing the work's dynamic formal design as it emerges from its sonic materials. In Chapter 3, Konrad Boehmer investigates Gottfried Micheal Koenig's *Essay* (1957/1958). Through the examination of this work's realization score, Boehmer devotes particular attention to the various processes needed to realize the piece. What is especially interesting about this analysis is that it is not so much an analysis of the product of the compositional process (the musical work itself) as an examination of the actual technical and compositional procedures that ultimately give rise to the musical work. Thus, the author affords the reader an intriguing look at this pioneering composer's thinking vis-à-vis the creative process.

The works examined in the next two chapters, both written in the 1960s, exemplify a compositional approach that further integrates the different aesthetics of *musique concrète* and "electronic music," not only through a deepening convergence of sound source materials but through compositional methodology as well. In Chapter 4, through the use of sonograms and amplitude graphs, the editor presents an analysis of Luigi Nono's first electroacoustic work, *Omaggio*

a Emilio Vedova (1960). The images of these sonograms differ dramatically from those found in the analysis of *Diamorphoses*, most notably by the fact that the sound material of *Diamorphoses* was drawn from prerecorded, real-world sounds, while those of *Omaggio a Emilio Vedova* are entirely of electronic origin (the only electronic piece that Nono created in this way). In Chapter 5, Jerome Kohl investigates Stockhausen's work *Telemusik* (1966). Kohl approaches his analysis through an examination of this work's study/realization score. After providing a broad overview of Stockhausen's evolving thoughts on the subject of serialism, Kohl details the composition's overall moment-form as it relates to both its serial and nonserial moments as well as its electronic and nonelectronic moments.

With advancements in digital technology during the 1970s and early 1980s came the arrival of progressively more powerful and accessible digital computer systems, dramatically transforming the musical landscape of sound production and composition. Jean-Claude Risset, a pioneering composer and researcher, has commented on the considerable importance of computer applications in electro-acoustic music: "The computer can serve as a refined tool to probe into the deep microstructure of sound. It can help to set up situations whereby the composer can interact in various ways with his sound material, develop formal, graphic, gestural or sonic representations, and experience the control of sound and music both sensually and intellectually" (Risset 1996, 176).

The works examined throughout the last four chapters, all written in the 1980s, are by composers who, in a variety of ways, have used the computer in realizing their musical soundscapes. In Chapter 6, Otto Laske presents a procedural analysis of his piece *Terpsichore* (1980). While discussing his use of "outside-time" structures both compositionally and analytically, Laske considers the compositional processes and overall sonic design of this work as well as the integration of the computer programs and systems used in its construction. He concludes with a discussion of another piece written some twenty years later, *Trilogy* (1999–2001), a work that employs similar compositional methods but was created with altogether different technologies. In Chapter 7, Agostino Di Scipio examines Jean-Claude Risset's *Contours* (1982). Through detailed examination of the Music V instrument and score designs created by Risset for this work, as well as of his sketches and annotations (generously provided by the composer), Di Scipio surveys the resultant sound structures of the various synthesis techniques employed as well as their integration to the work's overall form. In Chapter 8, James Dashow provides an analysis of his own composition *Sequence Symbols* (1984). After furnishing an overview to the basic concepts of his generating-dyad compositional technique, Dashow illustrates the instrument designs of his computer orchestra and details the implementation of these instruments throughout the composition. In the last chapter, Kristian Twombly investigates *The Sea Darkens*, the first movement of Joji Yuasa's text piece, *A Study in White* (1987). Using sonograms of electronic and vocal sounds, Twombly examines the evolution of this work's many local and large-scale oppositional relationships. It is especially interesting to consider this analysis

alongside those of Xenakis' *Diamorphoses* and Nono's *Omaggio a Emilio Vedova*, for all three employ the same technology for the computer-aided analysis of sound, sonograms.

This book represents not only a collection of analyses of electroacoustic works but also a collection of diverse and wide-ranging perspectives on the nature of analysis itself. Of course, the diversity of analytic approaches encountered throughout these chapters reflects the diversity of compositional approaches undertaken by this extraordinary group of composers. One hopes that these chapters will act as a point of departure for further investigations, and not only into music composed for tape alone but also into the myriad of other means and forms of creating music with modern-day technologies. As the field of electroacoustic music continues to grow, music theorists will be continually challenged. New, as yet unimagined analytical approaches will be envisioned, bringing us ever closer to a greater understanding of the medium known as electroacoustic music; a medium that continues to inspire, for the composer and listener alike, new modes of inquiry, reflection, and discovery.

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1

Through the Sensory Looking-Glass: The Aesthetic and Serial Foundations of *Gesang der Jünglinge*

Pascal Decroupet and Elena Ungeheuer

Gesang der Jünglinge is an emblematic composition, both for its composer and for electronic music. In spite of certain bitter opposition due to the use of a child's voice, at the time of its premiere this work gave the feeling that the phase of etudes was over; we are faced here with an opus, in the most emphatic sense of the term. In the context of European work of the 1950s, it played the role of a real turning point in musical thought, on the one hand, precipitating certain beginnings of a broadening and reassessment of serial thought as it had been formulated in the first half of the decade and on the other hand, making this same thought permeable to some new influences or interpretations. Its antecedents date back to some instrumental works conceived only in anticipation of new technical means; later on, certain strategies implemented here would lead to *Kontakte* and the concept of "Momentform."

In the autumn of 1951, Pierre Schaeffer opened the doors of his studio for *musique concrète* to a younger generation of composers, in order to carry out a consciousness-raising training course. The works most resolutely turned toward the serial universe were the two *Etudes concrètes* produced by Boulez, at the end of 1951 and at the beginning of 1952, respectively. Their bases are significantly different from those of the *Konkrete Etüde* that Stockhausen undertook in December 1952. Boulez abides by the natural facts of the materials used (duration and dynamic curve, both functions of resonance) and applies to them a quantified system of the serial type, whereas Stockhausen, as early as the first phase of work, is seeking to constitute a malleable material that can, without restrictions, undergo a whole series of transformations—and this independently of its starting nature. This is the real beginning of work on pure sound, this amorphous "atom" of timbre, which it would be possible to order according to the same principles of global serial organization. The sense of projection is all-important: it is really a question of carrying the general, aesthetic, and technical principles right into the sound. In his first theoretical writing, "Situation des Handwerks" (1952), which remained unpublished at the time, Stockhausen summarized his then-current concerns in the formulation: "There is the consequence

that for a work *X* alone, tones exist which bear the ordering character *X* and only as such and alone in this work have their meaning."[1] The first legitimate realization in this direction, although still posing some problems,[2] is *Studie I*, which Stockhausen realized in the electronic music studio of the Westdeutscher Rundfunk in Cologne from July to November 1953. In *Studie II*, an expression of a new fundamental questioning, the fusion of the partials is improved, certainly, but the sonorities are also noisier than the crystalline constellations of *Studie I*. These studies made it clear that too simple an acoustic premise had been used: the conception of new timbres as stable entities. However, with the conclusion of *Studie II*, Stockhausen writes that "the majority of the sound phenomena that we know are 'nonstationary'"[3] and that such things as the attack, the decay, and the minimal duration necessary to identify a sound intervene in the perception of timbres of phenomena. He infers nothing less than a new definition of the series, as a "series of 'general factors of modification' . . . applicable, according to its internal functional definitions, each time to another sound aspect or several sound aspects at the same time."[4] From repeated hearing of *Studie II*, Stockhausen extracts new criteria of composition, which he calls "statistical" and which he presents to the public through his analysis of *Jeux* by Debussy.[5] He focuses his attention on the overall directional tendencies of movement: the change from one state to another, with or without returning motion, as opposed to a fixed state. These motions can be descending or ascending in relation to some scale or other (on the level of pitches: from low to high; in dynamics: from weak to strong; in tempo: from slow to rapid; etc.). There results a system comprising, if one sets aside the forms created by the superposition of several curves, five situations:

1. ＼ 2. ／ 3. ∨ 4. ∧ 5. ⋱ ⋰ ⋱

For his new electronic music project, Stockhausen derived the shapes of articulation for sound complexes in time from the articulation of a sound, in phases of attack, sustain, and decay. In a work from that time, Fritz Winckel describes these different stages in the following way: the attack is "the setting into acoustic oscillation" of the phenomenon; in the sustain phase, "the various partials react to each other and modify qualities of the sound at every moment"; finally, during the decay, "the timbre is destroyed gradually and is reduced to some elements which fade away."[6] Whereas the middle part requires more specific means of description and characterization, the extreme parts can in all cases be subjected to the same restricted whole of directionalities to produce a limited number of temporal forms: setting into oscillation and decay from high to low (1), from low to high (2), or these two forms combined (3) or setting into oscillation from low to high and decay from high to low (4).

1. 2. 3. 4.