WAVES SERIES

Electronic Music Machines

The New Musical Instruments

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Contents

Foreword

By the dawn of the new millennium, digital technology was no longer a miracle but a reality.

From electronic instrument-making to software applications, a new world of flourishing expertise swept across the globe within the sound sphere. This wave of nascent technologies began to weave cultural and counter-cultural influences together.

Creators, engineers, and developers lost no time in seizing the revolution for themselves.

Each to their own craft. “Home Studios” have undeniably transformed both the work and the environment of composers. The parameter of time springs to mind, a newfound freedom to experiment with the timescales of the creative process. Some might see an intimate quality in working at their computers and electronic hardware, armed with unbounded experiences that might seem endless and lawless; others might find the infinite choice disorienting.

Technological progress has unquestionably amplified the impact of new timbres.

Most instruments of computer-assisted music (CAM) are simply more elaborate versions of their very first generations.

Consider, for instance, hip-hop – more specifically, the recent variant known as “trap music.” Would this style ever find its way into music if the legendary TR-808 beatbox had never been invented?

As electronics developed in the 1990s, tubes were superseded by transistors. The Japanese inventor Ikutaro Kakehashi, a former watch manufacturer who became an

electronic instrument-maker, launched the TR-808 in 1980. Four years later, he was forced to abandon production due to a shortage of components and the arrival of the MIDI format. The 12,000 existing copies of his drum machine gradually found their way onto the secondhand market. Now finally affordable, Ikutaro's TR-808 established itself as the ultimate weapon in the two greatest musical movements of the late 20th Century, techno and hip-hop. Before long, it was the emblem of an entire generation.

The same principle also applies at larger scales. Communication between technology and creators has an extraordinary impact on learning and experience-sharing.

This sets the scene for Jean-Michel Réveillac's research into the many historical facets of electronic music, *Electronic Music Machines: The New Musical Instruments*, a unique source of information that delves even deeper into the reflections of his previous book, *Musical Sound Effects*, published by ISTE Ltd (2018).

Both books explore and illuminate the creative landscapes of these musical worlds, making a statement about technological progress that highlights the timeless diversity of innovators and their instruments.

This book contains a diverse series of chapters that transport the reader to new heights in understanding musical movements. We are gently encouraged to think about how the machines of the past and the present can be described and categorized, gradually working toward the invention of modern standards and tools. Exploring these pages reveals a prodigious maelstrom of knowledge, strongly centered around the practical aspects of making music. The second part of the book focuses on two recently developed machines: the "Octatrack" by the Swedish manufacturer Elektron and the "Electribe" by the Japanese manufacturer Korg. Jean-Michel Réveillac has a few surprises about these instruments for his readers.

Let us end by pondering a few words by researcher John C. Lilly (1915–2001).

"The true miracle is that the Universe created one part of itself to study another, and that this part, by studying itself, is ultimately able to discover the natural and inner reality of the rest of the Universe."

Léo PAOLETTI (Leo Virgile)
Composer and audio designer

Preface

If you would like to find out whether this book is right for you, how it is organized, and which conventions are used, you are in the right place.

Target audience

This book is for anybody who is passionate about sound, whether hobbyist or professional, whether primarily interested in sound recording, mixing, or broadcasting, whether a musician, performer, or composer.

A few sections require some basic knowledge of digital audio, computers, and electronics.

Organization and contents of this book

This book is divided into two focus areas. Chapters 1–8 are devoted to theory, whereas Chapters 9–12 are more practically oriented.

Theory:

– 1. Electronic Music;

– 2. When Revolution Holds Us in Its Grasp;

– 3. The MIDI Standard;

– 4. Sequencers;

– 5. Drum Machines;

– 6. Samplers;

– 7. Groove Machines;

– 8. Vocoders.

Practice:

– 9. Octatrack: Maintenance, Repairs, and Tips;

– 10. Octatrack: MIDI Sequences and Arpeggios;

– 11. Korg Electribe: Maintenance and Hardware Tips;

– 12. Korg Electribe: Software Tips.

Each chapter can be read separately. Whenever there are concepts that build on other chapters, references to the relevant sections will be included. The first two chapters are devoted to the topic of electronic music in general. These chapters provide a rudimentary background that may help to understand the other chapters.

If you are completely new to the subject, I highly recommend that you start by reading the first two chapters – everything else will be a lot clearer.

If you are a more experienced reader, I hope that you still discover new concepts that will expand your knowledge.

Appendices 1–5 contain some additional information and summaries. You will find, in the following order:

– CV/Gate;

– Digital Inputs/Outputs;

– The General MIDI (GM) Standard;

– Plugins;

– Control and MIDI Dump Software.

The book ends with a bibliography and a list of useful Internet links.

Conventions

This book uses the following typographical conventions:

– *italics:* reserved for important keywords, mathematical terminology, comments, equations, expressions, and variables when they are used for the first time. Some words and expressions borrowed from other languages are also indicated in italics.

– UPPERCASE: reserved for the names of windows, icons, buttons, folders, directories, menus, and submenus. Also used for any elements, options, or commands used in the window of a software program.

Comments are indicated as follows: NOTE.– They complement the explanations given in the main body of the text.

Each figure or table has a caption that may help to understand its contents.

Acknowledgments

I would especially like to thank the team over at ISTE, as well as my editor Chantal Menascé, for placing their trust in me, as well as the composer and sound designer Léo Paletti (Leo Virgile) for writing the Foreword of this book and for his time, attention, and patience.

Finally, I would like to thank my wife, Vanna, who supported me from the very first page of this book until the very last.

Jean-Michel RÉVEILLAC
February 2019

Introduction

For centuries, musical instruments were largely frozen in time, except for a few major technical evolutions, such as the transition from the fortepiano to the traditional piano (simply known as the piano), to cite just one example.

Figure I.1. *Fortepiano (left) and upright piano (right)*

A purist might remind you that there were significant changes in the design, shape, and mechanics of wood, strings, and brass instruments, as well as keyboards and percussions, between the Renaissance (17th Century) and the early 20th Century.

They would, of course, be correct, but these changes pale in comparison to the upheaval created by electricity in the musical world. The term “electricity” is somewhat of a generalization here – it encompasses the multiple more specific revolutions of electromechanics, electronics, computers, and so on.

The second half of the 20th Century was packed with musical innovations: the popularization of tape recorders, the invention of the first oscillators and the first sound effects (reverb, echo, filters, etc.), the introduction of transistors and later integrated circuits, the analog-to-digital revolution, the advent of computers, the first-ever synthesizers, and so on and so forth.

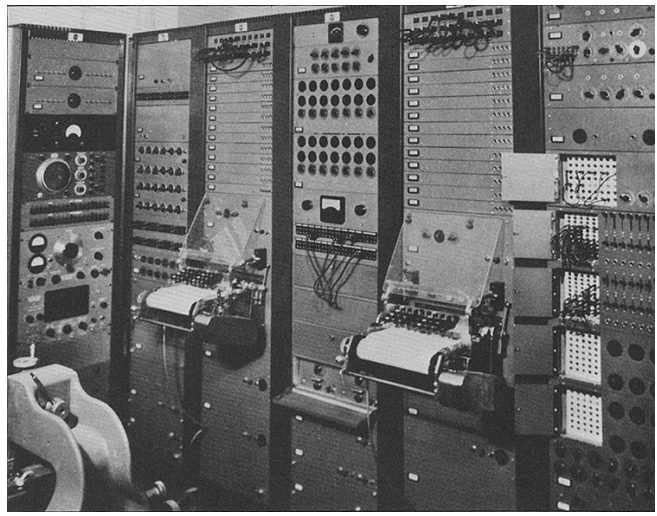

Figure I.2. *The RCA Mark II synthesizer, dating from 1955 (source: https://encyclotronic.com)*

Uncountably many technological devices – some highly sophisticated, others less so – quickly became indispensable in studios, both for composers and performers.

As for the creative aspects of musical compositions, new styles of music were unleashed upon the planet as musicians did not hesitate to take advantage of their new means of expression and creation.

Tape recorders were one of the key catalysts of the style of *musique concrète*, alongside electroacoustic, acousmatic, and experimental music[1]. They were also an essential factor in the formation of new genres of popular music[2] that shook the deeply entrenched norms of music to their very core. Techno, hip-hop, new wave, dance, house, ambient, acid jazz, electro, and much more: new anthems for the

1 See Chapter 1 of this book.

2 Here, the term “popular music” is used in a general sense (rock, blues, jazz, etc.).

electronic music generation. In just a few decades, so many new styles were born, and it has become difficult to keep track of them. But the steamroller of technological progress continued full speed ahead nonetheless, unearthing inventive and creative treasures to seed the next generations of musical craftsmen in turn.

The appearance of electronics and the first synthesizers at around the same time supplied a vast new palette of sounds to work with. Traditional instrument-making was forced to accept and merge with electronics; this fruitful union produced new ways of writing music. New professions with nebulous-seeming titles emerged to reinforce the newfound technicity: sound designers, disk jockeys, ghost producers, sound creators, digital communication experts, etc.

Over time, the concept of a "home studio" began to take shape, empowering new generations of musicians to work without relying on the classical infrastructure of traditional sound creation. The lion's share of composing music could now be done at home, working independently. For the first time ever, composers could dispense with third parties (recording studios, mastering, engineers, technicians, producers, classical musicians and instruments, etc.) until the final stages of the creative process.

Figure I.3. *A "home studio" in 1995 (source: https://www.soundonsound.com)*

By the turn of the 21st Century, home studios were everywhere. Today, the same phenomenon has intensified further; not only do modern musicians have the means to design their own music, but they can also distribute and even promote it, subverting the musical production infrastructure that had previously reigned

supreme for decades. Online music, Web 2.0 and social networks, crowdsourcing[3], the cloud, shared networks, and so on have disrupted the musical economy. The major industry players have their work cut out for them; they must adapt and offer new services, or they will not survive. Their monopoly has crumbled; the modern digital economy is driven by individuals, copyright is under threat, and legislation has lost its sharp focus.

Modern technology plays a primordial role in the great shipyard of contemporary music. New ideas and concepts appear and disappear every day at the whim of engineers, inventors, designers, manufacturers, or even marketing trends.

This book attempts to paint a simple picture of the machines scattered throughout the modern electronic music community. Standing proud against their constantly changing environments, these devices, tools, and equipment have become the pillars of the musical world. They have become inescapable for composers, persistent markers that are immutable and indispensable for any serious musical endeavors. Whether on the radio, on TV, at the movies, at a concert, in a studio, or at home, sound engineers, artists, and composers are now both the primary consumers and the primary contributors.

Synthesizers, digital recorders, electronic sound effects, drum machines, groove machines, vocoders, samplers, sequencers, control surfaces, tablets, and computers are the foundational components of modern electronic instrument-making, invading every inch of the contemporary musical space.

3 Crowdsourcing refers to the process of using the creativity and expertise of a large body of people working as subcontractors to replace the work of a professional individual or business.

Figure I.4. *EMS VCS3 synthesizer featuring an independent keyboard (1970)*

In this book, I have deliberately chosen to focus primarily on peripherals, largely avoiding the topic of synthesizers, since these instruments have been discussed at great length in many other books, as well as the topic of sound effects hardware, which is explored in my previous book, *Musical Sound Effects*, also published by ISTE.

My hope is that these chapters will leave you with a broader and more refined knowledge of the electronic instruments that have enchanted the modern musical community, to the delight of anyone as passionate as myself about the magical and sometimes mysterious universe of electronic music.

1

Electronic Music

This chapter provides a definition of electronic music and presents some of the musical techniques that contributed to its ever-accelerating transformation over the past few decades.

1.1. *Musique concrète*

It would be tempting to claim that *musique concrète* (which translates literally to "concrete music") was the foundation of today's electronic music. Unfortunately, things are never quite that simple. The arrival of new technologies introduced various other new concepts, some even richer and more complex, which punctuated the evolution of music from the post-war era until the present day.

Who invented *musique concrète*? Even this question is not entirely straightforward to answer. Some might suggest that Pierre Schaeffer[1] invented this style of music in 1948 from the studios of the RTF (*Radiodiffusion télévision française*, the French national broadcasting organization from 1949 to 1964). But digging a little deeper quickly reveals that musicians such as Hector Berlioz, Claude Debussy, John Cage, Herbert Eimert, Jorg Mager, and many others were also experimenting with similar concepts, styles, and approaches.

1 Pierre Schaeffer, August 14, 1910–August 19, 1995. French engineer, researcher, composer, and writer who founded the *RTF Studio d'essai* in 1942, together with Jacques Copeau.

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First Edition. Jean-Michel Réveillac.

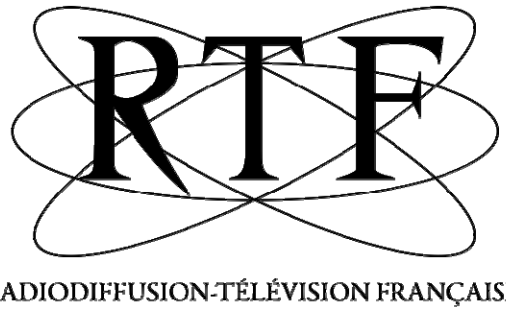

Figure 1.1. *One of the logos of the RTF (used between 1959 and 1964)*

Musique concrète was gradually conceived among a constellation of factors that contributed to shaping its ideas: technological advancements (tape recorders, sound generators, records, etc.), new art forms (cinema, television, radio, etc.), a period of musical renewal driven by new types of instrument (mechanical instruments, electromechanical instruments, electronic instruments, etc.), evolving environmental conditions for musicians (concert halls, studios, acoustic playback and reproduction equipment, etc.), and much more. This list is far from exhaustive.

Pierre Schaeffer can arguably be credited with popularizing *musique concrète* – if "popularize" is indeed the right word for such a niche style of music.

Before we go any further, let us take a moment to define and characterize exactly what the concept of *musique concrète* means. This is also the perfect opportunity to present some of the many musical styles that it has inspired.

Musique concrète has already been defined many times. However, it is often presented by invoking freshly minted terminology, the *raison d'être* of which seems to be to confuse or disorient amateurs and occasionally trip up even the most careful of experts.

Who better to define *musique concrète* than the man who originally introduced the term himself in 1948, Pierre Schaeffer?

The expression *musique concrète* was first immortalized on a paper in the article "Polyphonies", published in December 1949. In this chapter, Schaeffer offers a clear and precise explanation of the term: "We have called our music by the name of 'concrete' because it is made from preexisting elements, borrowed from various sound materials, including both noises and musical sounds, then arranged experimentally by a direct construction that realizes the composer's artistic

intentions without the help of ordinary musical notation, even if such help were not impossible".

1.2. The beginnings of electronic music

Armed with this definition of *musique concrète*, we are now ready to talk about *electronic music*, a much more nebulous concept – especially given how ubiquitous it has become today. We shall return to the modern view of electronic music later in this chapter. In its original context in the 1950s, Herbert Eimert[2], one of the inventors of the style, gave the following definition: "Unlike *musique concrète*, which uses microphone recordings, electronic music only uses electro-acoustically generated sounds. These sounds are produced by a sound generator and engraved on tape. They can then be processed by performing complicated and dynamic frequency band manipulations".

1.3. Electroacoustic music

The marriage of *musique concrète* and electronic music was preordained and inevitable, even if, on some level, they are opposing concepts. *Electroacoustic music* emerged as the fruit of their union in the late 1950s. Karlheinz Stockhausen[3] was one of the pioneers of this type of music.

Electroacoustic music mixes concrete sounds recorded by one or several microphones with purely electronic sounds. One of the most important early pieces in this style was "Song of the Youths" (*Gesang der Jünglinge*), composed by Karlheinz Stockhausen in 1956. Some even earlier pieces, such as *Orphée 51* by Pierre Schaeffer and Pierre Henry, *Déserts* by Edgard Varèse[4], and *Musica su due dimensioni* by Bruno Maderna[5], experimented with similar ideas.

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2 Herbert Eimert, April 8, 1897–December 15, 1972. German musician, pioneer of electronic music, founder of the *Studio für elektronische Musik* for the Cologne-based radio station WDR in 1951.

3 Karlheinz Stockhausen, August 22, 1928–December 5, 2007. German composer, pioneer of electroacoustic music and the spatialization of sound.

4 Edgard Varèse (Edgar Varèse), December 22, 1883–November 6, 1965. French composer who later gained American citizenship, widely acclaimed as a pioneer of 20th-Century music.

5 Bruno Maderna (Bruno Grossato), April 21, 1920–November 13, 1973. Italian composer and conductor.

In the 1960s, the term *electroacoustic* quickly became murkier, which was widely abused as a one-size-fits-all description for anything with elements of instrumental, concrete, and electronic music.

It is worth noting that any purely electroacoustic works from this period were almost entirely limited to recordings. Direct playback was extremely difficult to implement with the equipment that was available at the time, although this did not stop some artists from experimenting with it.

Figure 1.2. *The Cologne-based radio station WDR, one of the workplaces of Karl Stockhausen. This studio was one of the first-ever electronic music studios*

1.4. Acousmatic music

During the same period, in parallel with *musique concrète* and electronic music, the musical community embraced another new concept, *acousmatic music*. The objective of acousmatic music is to experiment with the listeners' sense of hearing and their mental perception of musical messages to leave room for the imagination. The word "acousmatic" refers to an auditory situation where the sound source is not visible, e.g. when listening to the radio or the off-screen voiceover of a documentary. Acousmatic music is intrinsically bound to its platform; it must be played on the same medium on which it was recorded. The sound materials carried by the medium are carefully crafted, sculpted, and shaped by the composer. They can feature any type of sounds (instruments, noises, voices, and synthetic sounds, which are deformed, chopped up, transcribed, inverted, looped, filtered, sped up, stretched, compressed, etc.). During playback, the acousmatic composition is

reproduced by a potentially elaborate array of equipment (inside an *acousmonium*[6]), often with an orchestra of speakers with different acoustic properties to play signals at specific volumes with specific acoustic colors, much like a traditional orchestra of instrumentalists.

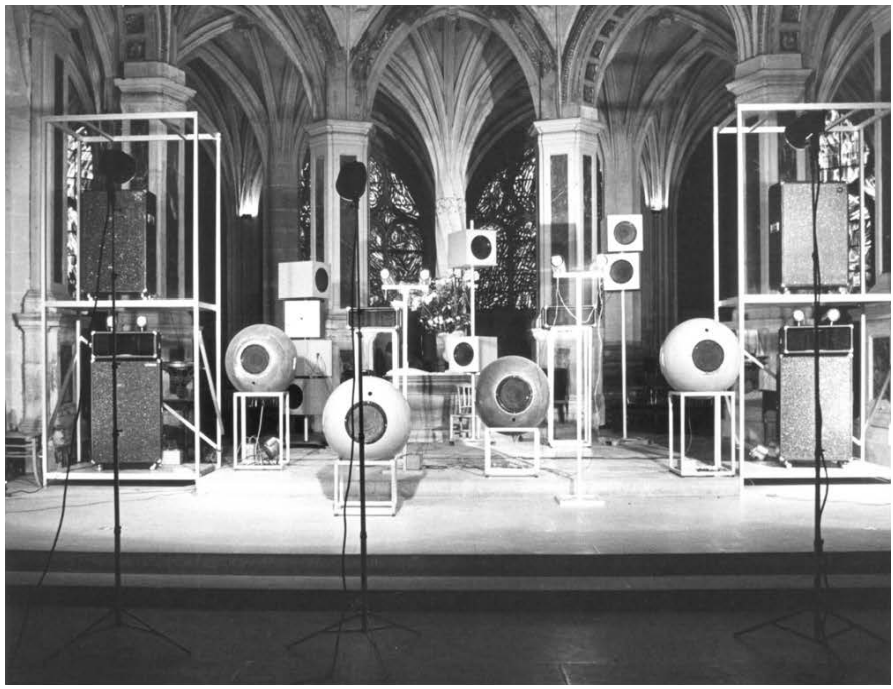

Figure 1.3. *An acousmonium with an orchestra of speakers (source: https://inagrm.com)*

The word "acousmatic" was coined by the philosopher Pythagoras, who used it to describe his personal style of teaching. The Ancient Greek thinker spoke from behind a curtain so that his students would only perceive the sound of his voice and would not be distracted by facial expressions and gestures. The term was dusted off and revived by the novelist and poet Jérôme Peignot[7] in 1955.

6 Acousmonium, a playback room or auditorium, also known as a sound projection room, containing multiple speakers arranged and staged in various ways according to the specific requirements of a piece of acousmatic music. The sound message can be played monophonically, multiphonically, stereophonically, on three or more channels, etc.

7 Jérôme Peignot, June 10, 1926. French novelist, poet, and typographer.

1.5. And much, much more

Even after defining *musique concrète*, electronic music, electroacoustic music, and acousmatic music, we are still far from having exhaustively covered every form of music that emerged between the 1950s and today. We could, for example, continue by mentioning experimental music, mixed music, tape music, computer music, live electronic music, subaquatic music, minimalistic music, spectral music, and so on. This list is just a small taste of the sprawling diversity of music and broadcasting phenomena inspired by *musique concrète* and technological advancement. In parallel, the ebb and flow of various trends gave rise to creative movements that proceeded hand in hand with specific musical styles, both old and new: krautrock, ambient music, progressive rock, wave, no-wave, disco, funk, etc.

1.6. Maturity

It is impossible to remain fully objective and neutral when judging the maturity of music. The maturity of which style, exactly? Some musical styles are still being born, while others have disappeared. Combining everything under the single label of "electronic music" reflects the modern reality of the style, despite being something of a catch-all description.

Throughout this book, we shall view electronic music as sound content that combines traditional and/or electronic instruments with a wide range of acoustic processing equipment to enhance playback and listening, whether live or on a recorded medium.

In historical terms, I would personally suggest that the experimental period of electronic music ended with the arrival of the first synthesizers in around the 1960s; electronic music has arguably been mature as a style ever since.

We shall mention specific music styles wherever relevant throughout each chapter of this book, noting the corresponding periods and dates where necessary.

1.7. Different paths to music

A new movement known as *serial music* first emerged in the early 20th Century, initiated by Arnold Schönberg, Alban Berg, and a few others to replace *tonal music*, which had predominated since the 18th Century. Serial music adopts a new approach to writing and composing music by arranging its 12 chromatic sounds according to the enumerative and non-repetitive principle of *twelve-tone serialism*