



Universiteit
Leiden
The Netherlands

Between air and electricity : microphones and loudspeakers as musical instruments

Eck, C.H.Y. van

Citation

Eck, C. H. Y. van. (2013, December 17). *Between air and electricity : microphones and loudspeakers as musical instruments*. Retrieved from <https://hdl.handle.net/1887/22868>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/22868>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/22868> holds various files of this Leiden University dissertation

Author: Eck, Cathy van

Title: Between air and electricity : microphones and loudspeakers as musical instruments

Issue Date: 2013-12-17

Between air and electricity

Microphones and loudspeakers as musical instruments

PROEFSCHRIFT

ter verkrijging van de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof. mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op dinsdag 17 december 2013
klokke 16.15 uur

door

Cathy van Eck

geboren te Leidschendam in 1979

Promotiecommissie

1e promotor

Prof. Frans de Ruiter

2e promotor

Prof. Richard Barrett

Brunel University, London (UK)/

Instituut voor Sonologie - Koninklijk Conservatorium, Den Haag/Universiteit Leiden

Co-promotor

Dr. Marcel Cobussen

Overige leden

Prof. Dr. Nicolas Collins

Department of Sound, The School of the Art Institute of Chicago, Chicago (USA)

Dr. Kees Tazelaar

Instituut voor Sonologie - Koninklijk Conservatorium, Den Haag/Universiteit Leiden

Prof. Dr. Emily Thompson

Princeton University, Princeton (USA)

Prof. Daniel Weissberg

Hochschule der Künste, Bern (CH)

Prof. Dr. Kitty Zijlmans

Between air and electricity

Microphones and loudspeakers as musical instruments

Table of contents

Prefatory matters	10
Abstract	11
Acknowledgements	12
Introduction	14
Scope	14
Artistic research	16
Context	18
Own works	22
1. Actions of Memory (2003)	22
2. Hearing Sirens (2005–2010)	24
3. Oefening in stilzwijgend zingen (2005)	30
4. Medea werden (2006)	34
5. Blik na blik (2006)	37
6. Büchsen für Pandora – Musik aus der Dose (2006)	40
7. Hearing Sirens (2007) (for one performer)	42
8. groene ruis (2007)	45
9. dazwischen (2007)	47
10. Luftschlösser im Bau (2007)	50
11. Wings (2007 - 2008)	52
12. in blik (2008)	56
13. Mit Luft gebaut – Musik aus der Dose (2008)	59
14. Im freien (2008)	60
15. hout en snaren (2008)	63
16. Das Quartett oder Schumann im Netz (2009)	66
17. Ein Oktett für das Quartett (2009)	69
18. Song No 3 (2010)	71
19. When the sound of your voice slips through my fingers (2010)	76
20. Music Stands (2011)	80

21. Pièce d'ameublement (2011)	81
22. Stumme Diener (2011)	85
23. Geluid gemeten: nr. 23 & nr. 32 (2012)	87
24. Ways and Means (2012)	88
25. Klangverordnung – Die verbotene Klänge der Stadt Bern (2012)	91
26. Double Beat (2013)	93
27. Square Head (2013)	97
28. Extended Ears (2013)	100

1 Beyond the curtain: virtual sound sources and the "true nature" of microphones and loudspeakers 103

Konzertreform	103
Invention of sound reproduction technology: invisible music with the help of microphones and loudspeakers	105
Storage of air pressure waves	106
Transportation of air pressure waves	108
Amplification of air pressure waves	108
Between air and electricity	109
Microphones and loudspeakers in music	110
Microphones and loudspeakers: the musical instruments of our age?	113
The "true nature" of microphones and loudspeakers	114

2 Four approaches towards microphones and loudspeakers: reproducing – supporting – generating – interacting 123

Four approaches towards microphones and loudspeakers	123
Music and musical instruments	123
Musical instruments defined in the context of microphones and loudspeakers	125
Three categories of objects with which music can be made	128
Acts of sound creation as opposed to the referential character of sound waves	129
Representing sound reproduction technology as musical instruments or musicians in advertisements	131
From the phonograph as a musical instrument to the radio as a sound reproduction device	131
Musical instruments and sound reproduction technology	135
Semantic acts of sound creation	136
Recognising the music through the noise	137
Electricity decouples movement and sound	138
Approach 1: reproducing	140
Approach 2: supporting	141

Transparent technology	142
New technology but conventional musical instruments	143
Reproducing versus supporting	146
Alterations in music due to sound reproduction technology	147
Approach 3: generating	149
Dead tones: music without movement	151
Approach 4: interaction	154
Resonance and resistance	154
Transforming objects into musical instruments	156
Finding the resonance and resistance of microphones and loudspeakers	157
3 The sound of microphones and loudspeakers	158
Transparent devices made audible	158
Acoustic feedback	158
Unity of sound production with the use of microphones and loudspeakers	160
Acoustic feedback: an electro-acoustic oscillator	162
Some remarks on the history of acoustic feedback	163
A tuning fork oscillator	164
Some remarks on the tuning fork	166
Nineteenth century research on sound	167
Thomas Young: visualising sound	167
Hermann von Helmholtz: reversing the tuning fork notation	169
Hermann von Helmholtz: Mittönen, a second tuning fork experiment	170
Hermann von Helmholtz: reproducing human vowels with tuning forks	171
The tympanic principle and the tuning fork principle	174
Alexander Bell: using many metal rods to reproduce sound	175
Alexander Bell: using symmetrical metal plates to reproduce sound	177
Richard Eisenmann: an electric piano with tuning forks	179
George Dieckmann: a piano string oscillator	182
Bechstein, Siemens and Nernst: a piano with a loudspeaker	184
Relating the tuning fork and tympanic principles to the four approaches	187
4 Interacting with microphones and loudspeakers: movement, material and space	189
Three forms of interaction: movement, material and space	189
MOVEMENT	191
Movement 1: changing the distance between microphone and loudspeaker: Quintet by Hugh Davies	192

Some remarks on acoustic feedback in music: from mistake to music	194
Movement 2: introducing silence: Pendulum Music by Steve Reich	196
Movement 3: listening as a performative act: Bird and Person Dyning by Alvin Lucier	199
Movement 4: interacting with another sound source: Green Piece by Anne Wellmer	201
Movement 5: amplification only: Mikrophonie I by Karlheinz Stockhausen	203
Microphone movements in amplification: supporting or interacting?	207
Movement 6: moving loudspeakers: Speaker Swinging by Gordon Monahan and Three Short Stories and an Apotheosis by Annea Lockwood	208
From movement to material	212
MATERIAL	214
Material 1: everyday actions amplified: coffee making by Valerian Maly and 0'00" by John Cage	214
Some remarks on the sound of contact microphones	215
Material 2: musical instruments and contact microphones: Inside Piano by Andrea Neumann	217
Material 3: new instruments through amplification: Apple Box Double by Pauline Oliveros and Shozyg by Hugh Davies	220
Material 4: acoustic feedback through different materials: Nodalings by Nicolas Collins Back to a circle of feedback	225
Some remarks on the materiality of microphone and loudspeaker diaphragms	226
Material 5: every loudspeaker a different voice: Rainforest by David Tudor	226
Material 6: the audible becomes feelable: Aptium by Lynn Pook, and Merzbow	230
SPACE	234
Space 1: interaction between microphones and small spaces: Music for piano with amplified sonorous vessels by Alvin Lucier	234
Space 2: interaction between loudspeakers and small spaces : Loudspeakers in brass instruments and focused loudspeakers	236
Some remarks on spatialisation with loudspeakers	239
Space 3: interaction between loudspeakers and performance space:sofferte onde serene... and Guai ai gelidi mostri by Luigi Nono	240
Space 4: loudspeaker orchestras: Acousmonium by François Bayle	244
Space 5: sound unified in space and dispersed in space Performances by Eliane Radigue and Der tönende See by Kirsten Reese	246
Space 6: closing the acoustic feedback loop again: Hörbare Ökosysteme by Agostino Di Scipio	250
Overview of strategies for interacting with microphones and loudspeakers	252
Some remarks on composing with microphones and loudspeakers	253

5 Composing with microphones and loudspeakers	255
Using the four approaches for composing	255
Recognising the reproducing approach: the Edison tone tests	257
Composing with the reproducing approach: Nothing Is Real (Strawberry Fields Forever) by Alvin Lucier	259
Musical gestures and gestural identities	261
Gestural identity shifts: combining the supporting and interacting approach: Windy Gong by Ute Wassermann	263
Gestural identity shifts through sound only: snare drum pieces by Wolfgang Heiniger	266
Combining the generating and interacting approach	269
Composed relationships between body movements and resulting sound	270
Performers changing their identity: tubes by Paul Craenen	272
Open musical instruments	276
The reproducing approach controls the interaction: Open Air Bach by Lara Stanic	277
Resistances and resonances of microphones and loudspeakers	279
The future of microphones and loudspeakers: between air and electricity	282
Appendix 1 Technology of microphones and loudspeakers	285
Appendix 2 Biographies	290
Bibliography	304
Samenvatting	316
Curriculum Vitae	317
DVD 1	
7 Hearing Sirens	
8 groene ruis	
11 Wings	
12 in blik	
18 Song No 3	
25 Klangverordnung	
DVD 2	
9 dazwischen	

- 10 Luftschlösser im Bau
- 13 Mit Luft gebaut - Musik aus der Dose
- 15 hout en snaren
- 16 Das Quartett oder Schumann im Netz
- 17 Ein Oktett für das Quartett
- 19 When the sound of your voice
- 21 Piece d'ameublement
- 22 Stumme Diener
- 23 Geluid gemeten
- 24 Ways and Means
- 27 Square Head
- 28 Extended Ears

CD 1

- 7 Hearing Sirens [sound file for performance]
- 17 Ein Oktett für das Quartett [sound file for performance]
- 25 Klangverordnung [sound file for performance]
- 27 Square Head [sound file for performance]

CD 2

- 3 Oefening in stilzwijgend zingen [sound file for performance]
- 5 Blik na blik [concert recording]
- 14 Im freien [concert recording]
- 15 hout en snaren [concert recording]

Prefatory matters

This dissertation is written in partial fulfilment of the requirements for the doctoral degree program docARTES of the Orpheus Institute and Leiden University. The remaining precondition consists of a concert, two DVDs and two CDs with video and audio material documenting several of the 28 compositions written for this doctoral project, and two websites (one with further documentations of all 28 compositions written during the doctoral trajectory: www.cathyvaneck.net/ownworks/, the other containing audio and video examples of the works discussed in this text: www.cathyvaneck.net/videoexamples/).

Abstract

My research takes the artistic use of the devices that bring sound waves into electricity and back as its central focus point; they are commonly called microphones and loudspeakers. These devices have become essential for many forms of music making. Through the same pair of loudspeakers, people listen to diverse music and sound, such as violin sonatas, rock songs or simply the latest news. Accordingly, microphones and loudspeakers are often designed to remain transparent; that is, "inaudible" in the final sound result.

From the 1950s on, microphones and loudspeakers started to play a crucial role not only in the mere reproduction of sound, but also in the creation of music. Composers and musicians often described these new possibilities of using microphones and loudspeakers as musical instruments. This resulted not only in many pieces and performances that used microphones and loudspeakers in unusual ways but also in many new possibilities for musical composition.

Confronted with microphones and loudspeakers through my own practice as a composer using electro-acoustic media, I investigated how microphones and loudspeakers could become musical instruments. This resulted in 28 compositions and a text about historical, theoretical, and practical aspects of the subject. To obtain a clear picture of the possibilities of microphones and loudspeakers in music, I develop four approaches in my dissertation. Three of them focus on the transparent use (*reproducing, supporting and generating*). The fourth approach focuses on the use of microphone and loudspeakers in an opaque way; that is, as musical instruments. I call this the *interacting* approach, since the music should, in contrast to the other approaches, not be transmitted through microphones and loudspeakers, but formed, coloured, and changed by these devices.

The fourth approach was the starting point for 28 compositions, in which I investigate in what ways one could interact or "play" microphones and loudspeakers. This resulted in a categorisation of three interaction parameters: *movement, material* and *space*. I looked at how these interaction parameters might be recognised in the work of other musicians and composers, as well as how the interaction with microphones and loudspeakers influenced compositional form, the performance situation, and the relationship between musician and musical instrument. This resulted in a theory and praxis in which I elaborate upon unique features of music, composed with microphones and loudspeakers.

Acknowledgements

My research would not have been possible without the support and help of many others.

Richard Barrett has been my mentor for many years and has led my research in the right direction, giving important input for the development of my compositions and has brought numerous musicians and composers, discussed in my thesis, to my attention. The intensive discussions with Marcel Cobussen and his engaged critique have been very helpful to order my thoughts. Frans de Ruiter has accompanied my work on my thesis with attention and enthusiasm. All three have thoroughly read, corrected, and commented on my manuscript at several stages of elaboration.

During my years in Berlin, Wolfgang Heiniger very generously shared his thoughts on electronic music and encouraged me many times to jump into the unknown. Owing to him, I got in touch with the Music and Media Art Department at the Bern University of the Arts, where I started to teach in 2007. Over the years, I have had many exchanges with my colleagues Ellen Fellmann, Michael Harenberg, Veronika Klaus, Valerian Maly, Beat Müller, Benoît Piccand, Iris Rennert, Marcel Sägesser, Peter Scherer, and Daniel Weissberg that have influenced my thoughts on my research subject. Notably, to pursue the developments of the research project *Klang (ohne) Körper*, initiated by my colleagues Michael Harenberg and Daniel Weissberg, has been very fascinating. My participation in the research project *Stimmung und Temperatur – Von der Schwierigkeit der Gleichschaltung*, initiated by Roman Brotbeck at the University of the Arts Bern brought me many new insights on nineteenth century acoustics. To share my ideas with my students as well as often trying them out in hands-on situations has been not only useful for my research but also very enjoyable.

For many of the 28 compositions, I had the opportunity to collaborate with many other artists, experimenting and exchanging ideas. I am very thankful to all of the artists with whom I have worked over the past years. Working with Andre Bayer, Nelly Bütikofer, Paul Craenen, Frederik Croene, Raphaela Danksagmüller, Alexandros Drymonitis, Kerstin Fuchs, Daniel Göritz, Susanne Kabalan, Juan Sebastian Lach Lau, Gerd Lünenbürger, Neue Vocalsolisten Stuttgart, James Orsher, Daniel Ott, Meriel Price, Matthias Rebstock, Teresa Rotemberg, Jan Schacher, Maren Schäfer, Tobias Schwencke, Wouter Snoei, Enrico Stolzenburg, and Susanne Zapf enlarged my horizon and provided me with many new ideas. I am also very grateful to all the concert and festival

organisers whose host I was over the past years and without whom I could never have tried out how my ideas function live on stage.

During my research I have had the opportunity to converse or correspond with many of the artists whose work I discuss. Sometimes I even got a private demonstration of a work or technology. I thank Paul Craenen, Wolfgang Heiniger, Annea Lockwood, Valerian Maly, Andrea Neumann, Kirsten Reese, Lara Stanic, Birgit Ulher, Ute Wassermann, and Anne Wellmer for sharing their time and thoughts on their work with me. I am grateful as well to the many experts who provided me with invaluable insights. My conversations with Klaus Heinz, Onno Mensink, Daniel Ploeger, Peter Swinnen, Kees Tazelaar, and Alvis Vidolin have extended my knowledge on many specific subjects in this thesis.

My research took place in the framework of the doctoral degree program docARTES of the Orpheus Institute and Leiden University. I would like to thank everybody involved in these institutions for the support they gave me during these years. Sandra Paine and Sharon Stewart have done the editing of my text, for which I am very grateful. My sincere thanks goes also to my parents and sisters—all musicians—who supported me in many ways. We exchanged opinions on many of my works and even shared the stage occasionally. Many thanks to the ones I did not have to mention since they know that I could not have done, or do, without them. Last, I have to acknowledge that, while so much knowledge and critique of others has made this work better, the remaining faults and mistakes are entirely my own.