SEE THIS SOUND

AUDIOVISUOLOGY
A READER

Edited by
Dieter Daniels and Sandra Naumann

In today's audiovisual media culture, the combination of images and sounds is a matter of course. The technical and aesthetic boundaries between the two have become fluid. Digitization has broken down auditory and visual information into bits and bytes that can be linked or translated at will. At the same time, a theoretical interest in the concepts behind the combination of images and sounds has emerged, uniting the arts and their history.

Since the end of the nineteenth century, with the rise of technical media, efforts have been made to reproduce, intensify, expand, and finally to transfer audiovisual perception to virtual worlds that promise to fulfill utopian fantasies of synthesis. In the tension between naturally and artificially (or artistically) produced audiovisuality, between its immersive or analytical implementation, the question arises to what extent we actually are conscious of what happens between the auditory and the visual realms. The convergence of the audiovisual is not just a matter of technology—perception research also increasingly calls the separation of the senses into question.

At the same time, there is no genuinely audiovisual discourse about hybrid audiovisual artworks themselves: these are usually evaluated in specific context, localized, for example, either in the visual arts, in music, in film, or in club culture. Critical debate conforms to different standards in each case, while it also often ignores one of both sides of the audiovisual construct. Even if media culture has become multisensory, an established "in between" that could do justice to hybrid art forms does not yet exist.

This new edition of *See This Sound. Audiovisuology* combines two volumes in a single reader and can be seen as a sizable contribution to filling this gap:
The first volume, "Compendium," bundles information from individual academic disciplines and offers a comprehensive foundation of knowledge on the diverse relationship between images and sounds.
The second volume, "Essays," offers in-depth studies on the historical development and the theoretical framework of our audiovisual society.

Even though an established discipline of audiovisuology does not (yet) exist, it takes shape here as an intersection—or, better, a sum—of the thematic areas. This publication reveals audiovisual research to be one of the great fields of experiment in the modern era—one which, like the project of modernism as a whole, has not been and cannot be brought to a close.

Audiovisuology—new edition—two volumes in one reader!
Audiovisuology is not a new science, but the intersection of all existing research on audiovisual art forms and related disciplines. This book is the first comprehensive publication on the relation of sound and image in art, science, and technology.

Volume 1. Compendium: An Interdisciplinary Compendium of Audiovisual Culture

The first volume is an extensive compendium of texts that explore both the different art forms in which image-sound relationships play a significant role as well as the methods that have been used to link acoustic and visual phenomena. Thirty-five separate articles describe the entire spectrum of the audiovisual arts and of audiovisual phenomena by means of longitudinal sections of history and systematic cross sections, while examples are presented in abundantly illustrated analyses of individual works.

Volume 2. Essays: Histories, and Theories of Audiovisual Media and Art

The second volume offers multiple perspectives on the hybrid cultural field between image and sound. The essays deal with such topics as the archeology of audiovisual media between science and art, mutual influences between pop culture and the visual arts, the hybridization of machines and emotions in the process of artistic production, and the search for intensitiy in audiovisual environments with a focus on their bases in the psychology of perception.

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Volume 1. Compendium
An Interdisciplinary Survey of Audiovisual Culture

Themes
Abstract Film / Animation / Architecture / Artist-Musicians / Cinedance / Color Organs / Dance / Expanded Cinema / Film Score / Games / Gesamtkunstwerk / Graphic Notation / Interactive Art / Light Shows / Literature / Live Visuals / Music / Music Video / Musical Theater / Painting / Performance Art / Software Art / Sonification / Sound Art / Sound Design / Video
Audiovisual Perception / Color-Tone Analogies / Conceptual Correlations / Montage / Parameter Mapping / Structural Analogies / Synchronization / Synesthesia / Transformation

Volume 2. Essays
Histories and Theories of Audiovisual Media and Art

- Hybrids of Art, Science, Technology, Perception, Entertainment, and Commerce at the Interface of Sound and Vision
- Separation and Conjunction: Music and Art, circa 1800–2010
- Deaf Dumb Mute Blind: Artistic Approaches to Image/Sound Relationships in Pop Culture
- The Expanded Image: On the Musicalization of the Visual Arts in the Twentieth Century
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- On Hearing Eyes and Seeing Ears: A Media Aesthetics of Relationships between Sound and Image
- The Question of Thresholds: Immersion, Absorption, and Dissolution in the Environments of Audio-Vision
- Audition and Ergo-Audition: Then and Now

Compendium

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Introduction

Dieter Daniels and Sandra Naumann

The Perennial and the Topical

The time span and thematic area covered by this compendium range respectively from antiquity to the present day and from philosophical models to existing apparatus and tools, for example from the Pythagorean theory of universal harmony to the audiovisual software of music visualization plug-ins for mp3 players. The immense field under examination, both with respect to its content and its history, is, however, held together by an abundance of cross-references. This introduction will examine how apparently perennial, supra-historical questions are intertwined with highly topical issues. The relationship between history and the present is at times almost paradoxical here. Scientific and technological progress may lead one to believe that a wealth of conundrums and false turns from antiquity to the eighteenth century have been definitively resolved, whereas in actual fact questions that have been debated for hundreds and thousands of years are still being reformulated in similar ways today. The differences in methodology and chronology found across the many arts and sciences concerned complicate the issue further. This compendium seeks to address the problem by examining the subject matter from multiple specialist perspectives and by approaching it from two different angles: both historically (in section I) and systematically (in section II).

The point of departure is a review of the artistic fields and forms in which the current multiplicity of relations between sight and sound manifests itself.[1]

In today's media-oriented society, the coupling of images and sounds has become as ubiquitous as it is inescapable. Through audiovisual technology, not only hearing and seeing, but also the aesthetics, technology, and economy of the visual and the auditory have become connected with one another in multifaceted ways. This applies equally to our leisure activities and our work environments, to the active production of audiovisual content, and to the reception of the mass media. As indicated by the neologism "prosumer," production and consumption can no longer be sharply distinguished. Embedded as we are today in an audiovisual media environment, we find it difficult to imagine a time when the technical ubiquity of images and sounds did not exist. Yet we need

1 The analysis of the topic's history, proceeding from the present day, is the leitmotif of the entire *See this Sound* project, including the associated exhibition. Cf. Dieter Daniels and Stella Rollig, preface to *See This Sound. Promises in Sound and Vision*, Lentos Kunstmuseum Linz, eds. Cosima Rainer, Stella Rollig, Dieter Daniels, and Manuela Ammer (Cologne: Verlag der Buchhandlung Walther König, 2009), 12.

only look back barely one hundred years to realize that for the longest period in the history of civilization, the auditory and the visual were not technically linked.

The history of sound-image correlations began long before the media age, as the reader will learn from many of the contributions to this compendium. Three distinct pre-histories, which are fundamentally separate but also selectively connected, emerge:

1 **The theory and practice of relationships between colors and sounds.**
Over history, numerous mythological, philosophical, mathematical, physical, and metaphysical models were constructed that postulated the correspondence of colors and sounds.[2] These models were often encyclopedic systems of analogies and references between planets, metals, the cardinal points, seasons, numbers, flora, and fauna; they were an expression of the yearning for a holistic formula to explain the world, which would subsume the cosmos and the psyche under the harmony of a higher order. They were also the point of departure for repeated experiments to construct color organs designed to translate such theoretical models into perceptible evidence, but these ultimately foundered on the reality that an intersubjective standardization of color-sound correspondences simply is not possible.[3] Although such models have been outmoded by modern physics research and media technology, they nonetheless dealt with questions that remain relevant today both for the study of neurological synesthesia and for the sonification and digital parameter mapping of visual and acoustic data.[4]

2 **The evolution of human perception.**
This concerns the differentiation and (re-)synthesis of hearing and seeing over the course of natural evolution and their subsequent cultural conditioning, an aspect of human evolution that is represented by multimodal integration as an element of the perceptual capacity of the individual.[5] Several anthropological theories dating from the early twentieth century are based on the assumption that the senses had a single common precursor from which the individual sense faculties developed over the course of evolution. Also, it is allegedly possible to demonstrate that certain "primeval synesthesias" existed over the course of human development and history.[6] Today, neurologists are exploring the hypothesis that during early neonatal development the sensory regions in the brain advance from synesthetic processing to neurologically differentiated, single-sense processing.[7]

3 **The combination of auditory and visual forms of expression in human culture.**
Since human prehistory, live performances of rituals and artworks have combined sight and sound as articulated by the body, voice, gestures, and

2 See the chapter "Color-Tone Analogies" by Jörg Jewanski in this volume.

3 See the chapter "Color Organs" by Jörg Jewanski in this volume and the comparison of different analogies in terms of the position of the color red in "Color-Tone Analogies" by Jörg Jewanski in this volume.

4 See the chapter "Synesthesia" by Hinderk M. Emrich, Janina Neufeld, and Christopher Sinke, the chapter "Sonification" by Florian Grond and Theresa Schubert-Minski, and the chapter "Parameter Mapping" by Tina Frank and Lia in this volume.

5 See the chapter "Audiovisual Perception" by Gerhard Daurer in this volume.

6 On primeval synesthesia, see Albert Wellek, "Die Farbe-Ton-Forschung und ihr erster Kongreß," *Zeitschrift für Musikwissenschaft* 9 (1927): 576–584.

7 See Daphne Maurer, "Neonatal Synaesthesia. Implications for the processing of speech and faces," in *Synaesthesia. Classic and Contemporary Readings*, eds. Simon Baron-Cohen and John E. Harrison (Oxford: Blackwell, 1997), 224. Also see the chapter "Synesthesia" by Hinderk M. Emrich, Janina Neufeld, and Christopher Sinke in this volume.

mimicry in dance, theater, and music, and with the support of costumes, masks, and musical instruments, not to mention the use of light. From sacred torch-lit dances in prehistoric caves to the sound of the organ under the stained-glass windows of cathedrals, the creation of an audiovisual whole was deemed to be an extraordinary experience, often with a spiritual meaning. Whereas these audiovisual expressions were bound to the moment of their execution, technical mass media have now enabled the conservation and reproduction at will of auditory and visual sensory impressions on film, video, and DVD. Nonetheless, live performance is currently experiencing a renaissance: especially in the live visuals found in club culture, the transcendence and corporeal immediacy of an audiovisual coupling on the basis of the new media are celebrated more excessively than ever before.

At all three levels, then, nature, culture, and technology overlap: the physical, physiological, and perceptual basic conditions, and their active and conscious human shaping through cultural and artistic practices as well as their potential expansion by means of technical media.[8] All three levels also show how the apparently perennial and highly topical aspects are intertwined with one another.

But for all this entanglement between history and the present, the state of knowledge is different today, while the questions we pose are also different to those of our predecessors for there have been three decisive changes in the boundary conditions:

— Since the development of modern physics and the work of Isaac Newton and Thomas Young, we know that light and sound are two entirely separate phenomena: sound waves are oscillations of pressure that travel through a gas, liquid, or solid, which is why outer space is silent (there is no air), while what we refer to as light is that small part of the electromagnetic spectrum visible to the human eye—the same spectrum that comprises both the microwaves of kitchen appliances and the long waves of radio bands. Physically, it is not possible to integrate the frequencies of light and sound in an overarching cosmic harmony, as has been attempted time and again since the days of Pythagoras, and neither can they be placed in a mathematically expressible proportional relation with the planets, metals, cardinal points, seasons, and so forth.

— We know that our sensory perception is the actual "location" where light and sonic waves meet to become audiovisual experience because we have eyes and ears and our brain processes and interrelates the signals from theses sense organs in parallel. The complexity of our system of sensory perception has tasked a number of scientific disciplines from Hermann von Helmholtz's physiology up to contemporary neurological synesthesia and intermodal research, but is still imperfectly understood.

— Since the era of Thomas Edison, we have been constructing many and diverse audiovisual media devices, which in the meantime have become an integral part of our lives. In the nineteenth century, the first cinematographs and phonographs occasioned amazement and even fright; today, by contrast, personal privacy and public spaces are invaded by pervasive and often aggressive audiovisual messages or by omnipresent "ambient media" that are perceived almost below the threshold of consciousness.

8 On the difference between automatic "multimodal integration" and the conscious and active creation of "intermodal analogies," see the chapter "Audiovisual Perception" by Gerhard Daurer in this volume. A model with five levels is developed by Michael Haverkamp.

Today we are aware that our synthesis of hearing and seeing is a complex, subjective achievement, which has no counterpart in the physical nature of light and sound. Thus, the centuries-old quest to discover an analogy in nature between optical and acoustic phenomena failed of necessity. However, we have created in audiovisual media a counterpart to our complex achievement of synthesis, which we take entirely as a matter of course and which surrounds us like a "second nature." The yearning for correspondences between sounds and images has been satisfied by a techno-cultural achievement, and not by speculation about the physico-mathematical structures of the optical and the acoustic. Nonetheless, the mathematical models of correspondence that have been developed since classical antiquity are more relevant today than ever before because digital technology has rendered the optical and the acoustic de facto calculable, transformable, and manipulable at will.[9]

A Possible and Impossible Chronology

The paradox inherent in the subject area (that it is at once perennial and topical) is also reflected in this compendium of audiovisuology. Compiling an overall timeline from the chronological depictions of individual art forms proves to be difficult. The time frames of the individual themes vary too much: the connections between painting and architecture, on the one hand, and music, on the other, go back to classical antiquity; the audiovisual techniques of synchronization date from the late nineteenth century; audiovisual software, sound design, and live visuals developed only in recent decades with the aid of digital technology.[10] At the same time, all of the academic disciplines involved have meaningful timelines for their own particular subject, and there are also a number of common historical reference points that are considered as being of key significance, albeit in each case for different reasons.

In this way, a web of parallel narratives develops that has interlinks and stretches of common history with attendant bifurcations, but possesses no universal model in which each of the art forms, media technologies, and media practices dealt with here has its explicit, historical, and systematically defined place. The biased perspective of academic disciplines is demonstrated in an exemplary way by the manner in which the auditory is separated from the visual. The "deafness" of the disciplines that engage with images, and the "blindness" of the disciplines that engage with music and sound are of seminal relevance to the central concern of this volume. The attempt to delineate the transdisciplinary field of audiovisuology encounters similar problems to those described by Bruno Latour for science studies: the socio-technical networks that exist between the individual disciplines are not visible from the perspective of the disciplines themselves; at the same time, they have real effects that constantly defy scientific explanation.[11] The main concern of this volume is to take the interconnection points and synergy effects of the different disciplinary perspectives and to render them useful within a network comprised of the theories and disciplines involved.

The study is also complicated by the fact that the speed of audiovisual praxis today far outstrips that of theory formation. In the areas that are currently most

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9 See the chapter "Parameter Mapping" by Tina Frank and Lia in this volume.

10 See the chapters "Painting" by Andrea Gottdang, "Architecture" by Ulrich Winko, "Synchronization" by Jan Philip Müller, "Software Art" by Golan Levin, "Sound Design" by Barbara Flückiger, and "Live Visuals" by Amy Alexander, all in this volume.

11 Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993), 3–11.

active, the process of defining historical situatedness and theoretical contextualization only begins retrospectively and at the same time serves as a strategy to legitimize the establishment of new forms of art. This is the reason why artistic self-contextualization often leads to historiography about precursors a posteriori, as in the example of the ocular harpsichord of Father Louis-Bertrand Castel from the eighteenth century, which is frequently claimed both as the forerunner of VJing as well as of audiovisual games and music videos. Particularly these very new fields often develop a desire for a historical pedigree, both with regard to their own ancestry as well as to the aforementioned genealogical research. Some genres, such as music video, for example, have in the meantime acquired the status of independent art forms; others, such as abstract film and abstract painting, are established art forms operating at the fringes. Some of these fields do have relatively clear time frames; for example, abstract painting as visualized music from around 1900 to 1920, or Absolute Film from 1920 to 1930.[12] In addition, there are thematic fields that defy classification in any of the established disciplines, forever lying "in between," and that for this reason have thus far been seriously neglected—the two-hundred-year-old history of color organs and the much longer history of color-sound analogies, which color organs sought to depict, are examples of this.[13] Scholarly research on these subjects risks treating them as relatively hermetic, specialist fields, as though they followed their own unique historic genealogy and an intrinsic logic that can only be explained in the context of their history. Yet it is especially this ambivalence and the negotiation of the position of such phenomena in the in-between that makes these topics highly interesting.

From this complex structure of mutually overlapping systems, extensive affinities, and mutual exclusions among the respective specialist narratives, two models can be extrapolated in the search for an overarching chronology. The first is a linear history of progress, which is oriented on the actual feasibility of the audiovisual and the technology that in the last approximately 150 years has brought forth the modern media-oriented society. The second model is a history of perennial ideas, whose origins reach far back into the ancient world; however, because these themes experience a revival in topicality from time to time, this leads to the constant recurrence of certain motifs, sometimes as conscious resumption and sometimes as naive reinvention. This permanent updating of the history of ideas is often driven by technical innovations of feasibility. To see this in terms of a one-sided cause-and effect-schema, though, is inadequate because time and again elements from the history of ideas stimulate the search for what is technologically feasible. This was already the case with Castel's ocular harpsichord mentioned above, which its inventor initially presented merely as a thought experiment. Through the debates it triggered, Castel found himself obliged to deliver the empirical proof by constructing such a device, an endeavor which was doomed to failure in view of the technology available at that time. Thus, in this case there is no right or wrong model of a chronology; both manners of representation have their specific justification. The result of this dichotomy is the difficulty of compiling a comprehensive, overall presentation that does justice to all aspects. Before this question is brought to a conclusion, however, it will be useful to sketch the two possible models of a chronology.

Perception and Apparatus: A History of Progress?

The history of audiovisual technology can be represented in a relatively clear

12 See the chapters "Abstract Film" by Sandra Naumann and Marcel Schwierin and "Painting" by Andrea Gottdang, both in this volume.

13 See the chapter "Color Organs" by Jörg Jewanski in this volume.

chronological order. Its far-reaching effects on the modern audiovisual environment are the main focus of the multidisciplinary perspectives of this volume. Since the advent of telephone, phonograph, and film at the end of the nineteenth century, and since radio, sound film, television, audiotape, and video in the twentieth century, audiovisual culture has undergone historically unparalleled expansion and reformation. All these media have redrawn the borders of the visual and the auditory and reconfigured their relations. In the beginning, in the nineteenth century, media first separated images and sound, then in the twentieth century united them again. This led to the development of a new diversity of machine-based artificial image and sound relationships. To cite just one example: the synchronization of films is the technical affirmation of Michel Chion's synchresis, which he defines as the natural psychological automatism of a motivic connection of simultaneous sounds and images.[14] The gaps remaining in these image-sound techniques have since become the area of activity of (media) artists, who deconstruct their apparent naturalism and recombine its elements so as to interrogate perception and medium on an ongoing basis.

Since the mid-eighteenth century, color organs have represented a kind of prehistory of audiovisual media. There were numerous models of these apparatus; some existed only as concepts, some were also actually constructed, and in each case they were heatedly debated.[15] One could also describe these models as pre-electronic media dream machines because they often sought to achieve more than was actually possible with the technology of the period; nonetheless, they anticipated image-sound effects that later emerged as experimental or innovative uses of audiovisual media.

Attempts to overcome the separation of image and sound using the media machines of the nineteenth century (photograph, film, phototelegraph, telephone, phonograph, gramophone) led to not very successful mixed forms such as the Kinetoscope or Kinetophone.[16] The synchrony of these media combinations of the mechanical, chemical, and electronic was constrained by clear limitations. It was not until the 1920s that a significant step in the development of audiovisual media was taken with the electrical processing of signals in optical sound. Here, the sound is recorded using a microphone and optically recorded as an oscillographic track on the edge of the filmstrip. Thus, for the first time, both images and sound are recorded on the same storage medium. The optical soundtrack is read with the aid of a photocell during its rendition and made audible via loudspeakers.[17] "An eleven-fold transformation is necessary for the complete metamorphosis, it is claimed," wrote Siegfried Kracauer of this process, adding that thus "the esotericism of technology today already surpasses that of the Eleusinian Mysteries."[18] The most important achievement of the optical form was the precise synchronization of feature films with language and music—resulting in the so-called talkies. And this had effects of greater import than the mere addition of sound: it led to fundamental changes in the aesthetics, methods of production, and economics of cinema films.[19]

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14 Cf. Michel Chion, *Audio-Vision. Sound on Screen* (New York: Columbia University Press, 1994), 63–64.

15 See the chapter "Color Organs" by Jörg Jewanski in this volume.

16 See the chapter "Synchronization" by Jan Philip Müller in this volume.

17 See the chapters "Transformation" by Jan Thoben and "Synchronization" by Jan Philip Müller, both in this volume.

18 Siegfried Kracauer, 1928, reviewing the first sound films in Siegfried Kracauer, *Der verbotene Blick. Beobachtungen, Analysen, Kritiken*, ed. Johanna Rosenberg (Leipzig: Reclam, 1992), 299.

19 See the chapters "Montage" by Hans Beller and Jörg Lensing, "Animation" by Maureen Furniss, "Film Score" by Helga de la Motte-Haber, and "Sound Design" by Barbara Flückiger, all in this volume.

Furthermore, optical sound facilitated for the first time direct inter-transformation of acoustic and optical signals. This is a technological necessity, albeit not the primary goal but a side effect of the work on synchronization. It inspired artists such as Oskar Fischinger and engineers such as Rudolf Pfenninger to explore the soundtrack as a creative medium. The far-reaching ideas only yielded a few isolated experimental results because of the complexity of the techniques involved.[20] The actual breakthrough to the universal formability of the audiovisual did not occur until the 1960s with analog electronics, and in the 1980s with digital technology.

Digital technology's development was highly diversified, which resulted in complex possibilities for coupling and transforming audiovisual data that far exceeded the "esotericism of technology" proclaimed by Kracauer in relation to optical sound. For this reason, the development of digital technology is explored in seven separate chapters in this volume.[21]

Electronic modulation of image-sound signals has repercussions for all existing audiovisual media that contain electronic components. Through digitalization, electronics integrate all current media formats. All the devices that once led separate lives in photography, film, video, radio, television, and audiotape now run as emulations in the universal machine of the computer, so that audiovisuality does not have to be generated by the combination of separate media, but is implicitly and explicitly already given.

To give a preliminary résumé of this history of technological progress: in the 1920s, it became possible to represent images and sound as analog, electrical oscillations; from the 1960s as audio-video signals; and from the 1980s as digital code in one and the same medium; with these innovations it also became possible to inter-transform, generate, and manipulate images and sound. This fact may now sound self-evident, but against the background of the long prehistory, its importance cannot be overestimated. Before the advent of technological media, human perception was the only place where sound and light came together. The centuries-old search for correspondences of images and sounds, which derived from the experience of human perception, was doomed to fail as an "anthropomorphism" for as long as it referred to the reality of these physically completely separate phenomena. It is only through audiovisual media that human perception has obtained a counterpart in the world of machines—the audiovisual is now located both in the human senses and in things.

A parallel might be drawn here between the history of technology and the biological and anthropological evolution outlined above: the increasing differentiation of the sensory organs to the point where acoustic, visual, haptic, and olfactory stimuli are separated is in a sense reversed in the history of media. The initially separate acoustic and visual phenomena are increasingly merged by technological progress. It is only in this way that the potential of audiovisual

20 Thomas Y. Levin, "'Töne aus dem Nichts.' Rudolf Pfenninger und die Archäologie des synthetischen Tons," in *Zwischen Rauschen und Offenbarung. Zur Kultur- und Mediengeschichte der Stimme*, eds. Friedrich Kittler, Thomas Macho, and Sigrid Weigel (Berlin: Akademie Verlag, 2002), 313–355. English version Thomas Y. Levin, "'Tones from out of Nowhere': Rudolf Pfenninger and the Archaeology of Synthetic Sound," Grey Room 12 (Fall 2003): 32–79; available online at www.centerforvisualmusic.org/LevinPfen.pdf (all Internet references in this volume last accessed on November 30, 2009).

21 See the chapters "Video" by Yvonne Spielmann, "Transformation" by Jan Thoben, "Software Art" by Golan Levin, "Parameter Mapping" by Tina Frank and Lia, "Interactive Art" by Katja Kwastek, "Sonification" by Florian Grond and Theresa Schubert-Minski, and "Live Visuals" by Amy Alexander, all in this volume.

technology approaches the primeval synesthesias of the human senses postulated by anthropologists and color and sound researchers in the 1920s.

The centuries-old dream of "eye-music," for which synesthesia has often been used as a metaphor, has thus mainly arrived in the reality of appliances since the rise of electronics. Without human associations or artistic interpretations having to be involved, it is possible to generate images and sounds automatically from the same signal, and to transform them into one or the other.[22] As in the case of optical sound, the means to transform images and sounds was not the goal of electronic media technology, which was actually designed for audiovisual production and reproduction. But from this basic technical principle a creative spin-off and artistically innovative use of electronics developed with its own, fascinating history. This ranges from the use of the oscilloscope for visual music in the 1950s films of Mary Ellen Bute, Hy Hirsh, and Norman McLaren, to Nam June Paik's TV experiments of the 1960s (in which he fed the audio signal of an audiotape into the cathode-ray tube of a television set), and then onward to an entire generation of artist-inventors, who in the 1960s and 1970s worked with audio and video synthesizers on special effects and manipulation techniques.[23] Finally, in the 1990s, digital signal processing enabled the mapping of images onto sound or sound onto images, as well as their simultaneous generation according to the same parameters. This created precisely what Golan Levin describes as "inexhaustible, infinitely variable, time-based, audiovisual 'substance'" that can be manipulated in real time.[24] In contrast to the mainstream history of technological progress, these artistic and experimental applications link back to the long history of ideas of visual music. Such creative use of electronics for purposes other than those intended thwarts their actual industrial and commercial functionality and the ostensible naturalism of audiovisual high definition.

The artistically motivated image and sound experiments in visual music during the 1920s, in intermedia art during the 1960s, and in media art during the 1980s have entered the hybrid culture of digital mass media as standard procedures. The now fluid technical boundary between image and sound has far-reaching effects on all established genres (e.g., image-sound montage in cinema films and television, live concerts with visuals, audiovisual ambience, and art installations). Its subliminal efficiency often has more significant consequences than are demonstrated manifestly in a direct image-sound transformation. The hybridization of the technical basis of all audiovisual media is of fundamental importance both aesthetically and economically. Because there is no longer any differentiation between the channels of distribution, models of marketing, and output media of sound and vision, the synthesis of the arts that the avant-garde movements of the nineteenth and twentieth centuries called for is no longer a question of technical feasibility. Instead, today the artistic genres are separated again more distinctly at the cultural surface than was envisaged by the new spirit of optimism surrounding visual music in the 1920s or in the intermedia euphoria of the 1960s. The theories of intermedia art and the Gesamtdatenwerk (integrated data work) may be technically realizable through digitalization, but they forfeit their character of a cultural utopia.[25] Unlike the

22 On the different approaches and processes to connect visual and auditory arts or phenomena, see the second section of this volume with its chapters "Conceptual Correlations" by Sabeth Buchmann and Rainer Bellenbaum, "Montage" by Hans Beller and Jörg Lensing, "Parameter Mapping" by Tina Frank and Lia, "Color-Tone Analogies" by Jörg Jewanski, "Synchronization" by Jan Philip Müller, and "Transformation" by Jan Thoben.

23 See the chapter "Video" by Yvonne Spielmann in this volume.

24 See the chapters "Software Art" by Golan Levin and "Interactive Art" by Katja Kwastek, both in this volume.

25 See the chapter "Gesamtkunstwerk" by Barbara John in this volume.

Gesamtkunstwerk (total art work) of the nineteenth century, today praxis is forging far ahead of theory. Accordingly, the audio and visual arena is situated less in high culture, which in many places is again defending the specificity of its genres and focusing them aesthetically, and more in mass-media-permeated everyday culture and the perceptional habits informed by it. The utopia and praxis of a programmatic, theoretical, and aesthetic emphasis has been replaced by the permanent linkage of image and sound as a commodity, which proves itself to be, for good or for worse, more of a way of life than an art form.

Eternal Recurrence—or Constant Reinterpretation?

A linear chronology of the evolution of relations between image and sound as outlined above is very straightforward from the perspective of media technology, especially, but still neglects important aspects of the historical multiperspectivity of the subject. In spite of this deficit, in many overview publications it is this history of progress that has become established as the way to present the subject.[26] However, a brief glance at the chronology sketched above suffices to show that image-sound relations are located at the center of a complex fabric of technology, aesthetics, perception, worldview, and economics, whose mixture of constants (physiological, physical, and some derived from the history of ideas) and variables (technical, cultural, and in the broadest sense ideological) cannot be depicted as permanent progress.

The history of the ideas of audiovisual synthesis is often far ahead of the history of technology. Feasibility sometimes only catches up with utopias when their most intense phase is already past. Absoluteness, which in Richard Wagner's day and again in the 1920s and 1960s was the basis for the demand for and expectation of increasing synthesis in "the artwork of the future," for the abolition of all boundaries between genres, and for universal audiovisualization of aesthetics, today is obsolete. Yet the arts have undoubtedly undergone extensive *Verfransung* (fraying). This metaphor of Theodor W. Adorno's clearly shows that although such fraying may blur the margins of the fields, it does not call the core area into question. The countermovement to the fraying of the edges is the conscious, radical return to one's own genre, as, for example, Clement Greenberg's modernism demands. To Greenberg, culture that focuses on its own medium is a bastion against capitalist kitsch that mixes all media and materials.[27]

Rather than permanent progress, one can certainly describe the two-hundred-year-old history of the color organ and related constructions by artist-inventors right up to audio-video synthesizers as a history of permanent failure. The search for an ideal, scientifically established, objective correspondence of colors and sounds, which some of the color organs were intended to demonstrate, proved to be unsustainable and not even capable of being universalized. It is not possible to justify specific linkages of image and sound scientifically or aesthetically; ultimately, they are based on individual preferences. Although intuitive access to the quality or intensity of the linkage of sound and image through direct experience of audiovisual culture is still possible, it is very difficult to abstract from this or make comparisons with other examples because we are virtually unable to name this "third party" situated between hearing and seeing or to subsume it under objectifiable criteria.

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26 For an example of a typical genealogy of progress, see Peter Weibel, "Von der visuellen Musik zum Musikvideo," in *Clip, Klapp, Bum. Von der visuellen Musik zum Musikvideo*, eds. Veruschka Bódy and Peter Weibel (Cologne: DuMont, 1987), 53–141.

27 See Clement Greenberg's famous essay "Avant-garde and Kitsch," *Partisan Review* 6 (1939): 34–39.

Comparable questions, which are just as irresolvable as those concerning perception, apply to the area of the relevant apparatus. These are hybrids located somewhere between a work of art, an instrument, and media technology. From Father Castel to Thomas Wilfred, all of their inventors and constructors hoped that they would proliferate on a massive scale. However, they do not possess the ability to achieve intersubjective consensus regarding a work of art, nor the instrumental universality of a musical instrument for very different types of music. For this reason, these hybrid devices remained tied to the performances of their creators for the most part; they often disappeared from the public eye together with their constructors and are only documented in descriptions or photographs. An additional complication is that neither the history of art, music, or technology appears to feel responsible for such hybrid apparatus; therefore, they are excluded from established institutions of conservation. This history of apparatus continues to apply today to the abundance of audiovisual software that has been developed, for which there is also no established context of cultural evaluation or archiving.[28] Yet the success of digital technology does relativize the aforementioned two-hundred-year history of failure. The technical reproducibility and universal functionality of digital interfaces, such as the Lemur by JazzMutant or Pioneer's DVJ-X1, are heralds of instrumental standards for the production of audiovisual artifacts. The same applies to the user interfaces of software of this kind: the computer enables the universality of applications, which are widely distributed as plug-ins and emulations and in their turn influence the aesthetics of production.

In this sense, the history of artistic and technical sound-image linkages can be regarded as an exemplary case for Adorno's proposition that "progress in art must not be denied; nor should it be proclaimed." And Adorno sees the "dual nature" of art—both social and autonomous—as the reason why it is "difficult to talk of progress as both present and non-existent."[29] The dual nature of art can also be confirmed for the dualism of art and technology, which is investigated in this volume. Technological progress is undeniable, yet the history of ideas about sound and image relations contains just as many examples of apparently eternal, recurring motifs, which are as fascinating as they are ultimately not entirely resolvable.

Therefore, the potential antithesis of a history of progress would be the ever-recurring questions, motivations, and aims of the perennial work on image-sound linkages. This could take the form of a conscious and intentional reprise, a historical reference, and new interpretation, as already exist in the history of art and history of music. In the history of image and sound relations, however, there are numerous examples of artists and inventors hitting upon innovative ideas and realizations without being aware that they are in fact part of a long tradition. In the history of art, music, and technology, those concerned tend to overestimate how innovative their work is. Particularly in the case of the color organ, but also in the wider field of audiovisual arts and apparatus, the belief that one is the first and only author of a specific idea is astoundingly pervasive. Adrian Bernard Klein, who invented such apparatus himself and also authored the first in-depth historical account of two centuries of color music, wrote in 1927: "It is an odd fact that almost everyone who develops a colour-organ is under the misapprehension that he, or she, is the first mortal to attempt to do

28 On the hybridity of aims and contexts, see the chapter "Software Art" by Golan Levin in this volume.

29 Theodor W. Adorno, *Aesthetic Theory*, trans. C. Lenhardt (London: Routledge, 1984), 298 and 300.

so."[30] Up until the present day, audiovisual products and software continue to be touted as absolute innovations and "revolutionary fusions of the senses."

One of the main reasons for these permanent reinventions is the fact that a history of audiovisuology does not exist, because due to the fact that image-sound couplings reside in a state of in-between, there has been no development of a specific theory or aesthetics and no canons have been established. In this respect, these reinventions only seem naive from a retrospective point of view; in their particular artistic, aesthetic, and technical situation, they were original and experimental, even when they were created outside any context of historical awareness. The recognition of the deficit of historical situatedness of one's own praxis motivates some of these artist-inventors to undertake retrospective genealogical research and often makes them recognized historians of their respective métiers.[31]

Unlike in the history of art or music, explicitly historical citations do not refer to a succession of epochs or styles, but often occur across all the historical periods and genres involved. For example, John Whitney, a pioneer of computer animation with his algorithmic visual music, refers explicitly to Pythagoras's doctrine of harmony.[32] On the other hand, there were certainly historical phases of intense concretion in the artistic and technical praxis of image-sound couplings, where the zeitgeist coalesced with available media technology and inspiration from the field of science. This was the case in the 1920s: the artistic Absolute Film, psychological research on color and sound, and the technological advances in radio and sound film were parallel developments, which at first were independent but later came together in spheres of mutual interest. Here, there was already the seed of an audiovisuology that spanned art, technology, and science, for example in Georg Anschütz's color-sound congresses and in the Bauhaus environment.[33] In the 1960s, too, intermedia art, expanded cinema, feedback video techniques, experimenting with drugs, and popular theories—from Marshall McLuhan to Timothy Leary—were all combined in the spirit of psychedelia.[34] In the 1990s, the club culture, analog sampling and scratching, new digital audiovisual software and hardware, and the need for visual additions to electronic music all complemented each other to give birth to live visuals. While it is not possible to offer an exhaustive treatment of these phenomena here, they nevertheless illustrate the permanent return of certain fundamental motifs—some as intentional historical references, some as naive reinventions as mentioned above.

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30 Adrian Bernard Klein, *Colour-Music. The Art of Light* (London: Lockwood, 1926), 21. Kenneth Peacock expressed much the same view: "Nearly every color-organ inventor in the nineteenth and early twentieth centuries was under the delusion that he or she was the first to conceive of color-music. Mary Hallock-Greenewalt is perhaps the extreme example. Her book is a self-panegyric in which she claimed in the opening pages, 'It is I who have conceived it [color-music], originated it, exploited it, developed it, and patented it.'" See Kenneth Peacock, "Instruments to Perform Color-Music: Two centuries of technological experimentation," *Leonardo* 21 (1988): 404.

31 The first standard work about color music is by Adrian Bernard Klein, who performed such experiments himself and only later became aware of the considerable history of the subject; see Adrian Bernard Klein, *Colour-Music.* The same applies today to VJing and audiovisual software, whose development is initially documented by the developers themselves.

32 John Whitney, *Digital Harmony. On the Complementarity of Music and Visual Art* (Peterborough, NH: Byte Books, 1980), especially the chapter "Pythagoras Revisited," 65ff.

33 The second Color and Sound congress held in Hamburg in 1930 was attended by psychologists, scientists, engineers, and artists such as Ludwig Hirschfeld-Mack, Zdeněk Pešánek, and Baron Anatol Vietinghoff-Scheel; see Georg Anschütz, ed., *Farbe-Ton-Forschungen*, vol. 3 (Hamburg: Psychologisch-ästhetische Forschungsgesellschaft, 1931).

34 "To this day, psychedelic art offers a suitable instrument for the analysis of synesthetic-artistic experiences in a world influenced by new technologies." Christoph Grunenberg, ed., *Summer of Love: Psychedelische Kunst der 60er Jahre* (Ostfildern: Hatje Cantz, 2005), 40.

Because such entirely diverse contexts and factors are always linked in audiovisuology, it is very difficult to develop a classification or a chronology for these fields. The cross-connections between the artistic genres and the scientific disciplines create a kind of network. As mentioned above with reference to Bruno Latour's term from science studies, the in-between areas only become visible through these socio-technical networks, which are mostly ignored from the perspectives of the individual disciplines. This complex structure can possibly described by the term "family resemblance"—a philosophical idea proposed by Ludwig Wittgenstein in his critique of language. Family resemblance does not develop in linear sequence like a chronology of progress, rather a unique and original mixture is created through overlapping similarities and differences that enables the determination of a typical similarity for which, however, there are no fixed and unchangeable criteria.

For this reason, the structure of relations in audiovisuology can best be described by the term "semantic network." A semantic network both enables and renders necessary a synchronic and a diachronic viewpoint, but for this reason inevitably eludes classical forms of knowledge representation. It will be achieved for this publication through the parallel forms of book and online platform. The linear history of technological progress and the cyclical history of ideas both have their raison d'être, although one of these alone cannot claim validity without admitting the other perspective. Only then does the more profound reason for the paradox of the perennial and topical nature of the subject mentioned at the outset become clear. This paradox is merely the symptom of the different models of a possible chronology that at once contradict and complement each other. Thus, the audiovisuology presented here is not a new discipline but a meta-level on which the convergence and divergence of audiovisual art forms, methods, and scholarly disciplines become visible.

Essays

Dieter Daniels, Sandra Naumann, Introduction Vol. 2, in: Dieter Daniels, Sandra Naumann (eds.), Audiovisuology, A Reader, Vol. 1: Compendium, Vol. 2: Essays, Verlag Walther König, Köln 2015, pp. 439 - 441

Introduction

Dieter Daniels and Sandra Naumann

The guiding theme of the contributions in this volume is the relationship between the auditory and the visual in art, media technology, science, and perception. The period covered spans from the eighteenth century to the present, with a particular focus on the twentieth century. This leitmotif is developed along four different thematic lines:

(a) the relationship between artistic genres and their respective aesthetic theories with reference to painting, sculpture, music, literature, and film;
(b) the coupling of images and sounds in the audiovisual media and artistic apparatus found in the realms of film, video, and immersive or interactive installations, as well as in their historical antecedents in the color-light art of the nineteenth and early twentieth centuries;
(c) the interplay between these techniques and human perception to the point of potential boundary experiences of multimodal synthesis, such as those that occur in the phenomena of cross-modality, embodiment, immersion, and dissolution;
(d) the convergence and divergence of visual and auditory codes in various forms of cultural expression, which has been thematicized, for example, in the artistic avant-garde of the 1920s, in the intermedia art of the 1960s and digital media art since the 1980s, and in pop culture since the 1960s, as well as in the reflection of pop culture in contemporary art since the 1990s.

The complexity and intricacy of the guiding theme is evidenced, for instance, by the fact that none of the ten essays ever deal only with a single topic, but rather always create links between different levels. For example, the questions of the definition of the artistic genres, their rivalry in the *paragone*, and their reciprocal influence—long-standing questions which Simon Shaw-Miller asks with respect to the period from the late eighteenth to the early twentieth century—are certainly a prelude to the dialectic relationship between visual and auditory codes, as outlined by Diedrich Diederichsen in reference to pop culture. The coupling of image and sound in media technology and the oft-forgotten contributions of the avant-garde artist-engineers of the first half of the twentieth century, which are recalled in Birgit Schneider's archaeological inquiry into the history of media technology, are likewise found at the interface between art and natural science, as are the immersive artworks examined by Chris Salter, given their connection with neurological research and studies on intermodal perception. Like Schneider and Salter, Katja Kwastek also wonders whether it is possible to draw boundaries between the technical apparatus, the performative instrument, and the reception-seeking artwork—a question that the author examines using the example of interactive art. The interplay between bodily proprioception and the transformation of the audiovisual by means of media

technology—dealt with by Michel Chion in terms of his concept of *ergo-audition*—is an important component, in turn, of the interaction between artwork and user or performer, explored by Kwastek, and of embodiment and immersion, dealt with by Salter. Finally, Hans Beller's analysis of classical film montage deals with related aesthetic phenomena, which are also studied by Christian Höller with reference to contemporary art and by Diederichsen with respect to pop culture: strategies of adaptation or even ingratiation of the auditory and visual levels encounter strategies of contradiction and unveiled incompatibility.

As already illustrated in the interdisciplinary compendium of this two-volume publication on "audiovisuology," this field of research comprises a terrain of overlaps, intermediate zones, and interferences. It is thus not a new science, but rather represents a new perspective on existing fields of knowledge; nonetheless, the new combinations created give rise to new knowledge contexts.[1] The aim, however, is not to establish a new discipline, but to open up and render more permeable the existing scientific disciplines. The field of audiovisuology outlined here can therefore exist only in a context of permanent dialogue between the fields of audiovisual theory mentioned above and in constant comparison with contemporary artistic practice, which often develops more rapidly than science.

Observation of the current state of research shows that in the realm of the audiovisual, practice is substantially more advanced than theory.[2] Vice versa, it also becomes evident, however, that the diversity and intensity of audiovisual practice is an essential impetus for the increased interest in the history and theory of combinations of image and sound. Today, the coupling and transformation of visual and auditory data by means of digital technology seems so self-evident that it is often presented as an ahistorical innovation—almost as a side-effect of the universal machine of the computer. Only against the background of the long history of struggles with audiovisual apparatus and media (often developed by artists themselves from the nineteenth century onward) does it become clear that the conceptual history of the audiovisual in turn influenced and shaped the history of its technology. Artistic (audio-)visions led to technical innovations, whereas today they often are understood only as the implementation of the potential contained in digital technology.

Nowadays, the integration of sound in the visual arts and the augmentation of contemporary (especially electronic) music by visuals are taken for granted. The pathos of a *Gesamtkunstwerk*, as championed by Richard Wagner at the close of the nineteenth century; the notion of a universal aesthetic validity that accompanied the endeavor to achieve a synthesis of the arts in the early twentieth century and that found concrete form in the "absolute film" of the 1920s and in the psychological and physiological color-sound research of the same era; and the aspiration for multimedia totality and the suspension of all genre boundaries, as formulated by intermedia art in the 1960s—all have today yielded to the unquestioned self-evidence of the audiovisual. Seen historically, the goal was always an overall design that encompassed not only the coupling

1 See Dieter Daniels and Sandra Naumann, eds., *See This Sound: Audiovisuology Compendium. An Interdisciplinary Survey of Audiovisual Culture* (Cologne: Walther König, 2010).

2 This view was expressed by the jury of the Prix Ars Electronica Media.Art.Research Awards—dedicated in 2009 to the topic of sound-image relations in audiovisual art—after having viewed the entries: "The conclusion of the jury thus was that artistic practice in its multimedial, multi-modal approaches to sound and image is further ahead than current theory in this interdisciplinary sense." Jury Statement Prix Ars Electronica Media.Art.Research Award 2009, by Dieter Daniels, Christoph Grunenberg, Cornelia Lund, Helga de la Motte-Haber, and Christopher Salter, in "Sound-Image Relations in Audiovisual Art," in *CyberArts 2009*, eds. Christine Schöpf, Gerfried Stocker, and Hannes Leopoldseder (Ostfildern: Hatje Cantz, 2009), 241.

of image and sound, but also a fusion of aesthetic theory and practice that would lead to a utopian unity of sensory perception. There are no longer overall designs of this kind for today's ubiquity of audiovisual art forms; rather, the advanced lead in practice mentioned above evidences a deficit at the theoretical level. And yet the omnipresence of the audiovisual has led neither in artistic practice nor in science to an ongoing discourse that spans all the genres. The valuation contexts of visual art, music, theater, and film are as separate today as they have ever been. Against this background, the compendium of audiovisuology should be understood as an attempt to link the perspectives of the individual scientific disciplines with one another.

The essays in this volume provide a critical review of the long search for possible syntheses between aesthetic theory formation and media technology practice. Whereas the individual art forms and technical procedures are presented chronologically and systematically in the compendium, the essays draw cross-connections between the four thematic levels mentioned above. The common goal is to reawaken awareness of the unquestioning acceptance of our media-based audiovisual environment as a matter of course, to once again render audible and visible that we live in the midst of a permanent artistic coupling of the auditory and the visual, and thus to allow both the possible synthesis and the contradiction between images and sounds to become explicit. Here and throughout the "See This Sound" project, the objective is to question the different artistic concepts, their models for value creation, and the relevant scientific disciplines and their concepts of truth.[3]

3 See also the exhibition catalog *See This Sound: Versprechungen von Bild und Ton / See This Sound: Promises in Sound and Vision*, Lentos Kunstmuseum Linz, eds. Cosima Rainer, Stella Rollig, Dieter Daniels, and Manuela Ammer (Cologne: Walther König, 2009).

Prologue

Hybrids of Art, Science, Technology, Perception, Entertainment, and Commerce at the Interface of Sound and Vision

Dieter Daniels

Dieter Daniels, Hybrids of Art, Science, Technology, Perception, Entertainment, and Commerce at the Interface of Sound and Vision, in: Dieter Daniels, Sandra Naumann (eds.), Audiovisuology, A Reader, Vol. 1: Compendium, Vol. 2: Essays, Verlag Walther König, Köln 2015, pp. 442 - 459

For an interdisciplinary theory that seeks to link the perspectives of different disciplines, the following questions as to methodology arise:[1]

— According to which criteria and paradigms are contemporaneous phenomena from different contexts comparable with one another?
— To what extent can certain phenomena be assigned to specific contexts without sacrificing their multiple points of reference and their hybrid identity to a far too simple categorization?
— Are the intentions of the authors (artists, inventors, developers) valid criteria for where to situate their artefacts (works of art, devices, concepts, productions), or should their actual usage (as artwork, technological device, scientific demonstration, entertainment) be the determining factor?

Like the 35 contributions in the *Audiovisuology Compendium*, the essays in this second *Audiovisuology Essays* volume traverse the contexts of art, technology, science, perception, entertainment, and marketing in multiple combinations and relations. For example, Katja Kwastek examines the ambivalence of audiovisual devices in their double role as an instrument and a work of art from the perspective of art history. From the point of view of media theory, Birgit Schneider demonstrates the hybridity of audiovisual experiments: the same artefacts are propagated by their authors partly with artistic, partly with technological, and partly with scientific goals. Chris Salter links theories from physiology and neurology with concepts of aestheticism to investigate artistic-sensual-technological border areas, which he also explores in his own artistical practice. As Simon Shaw-Miller's differentiation of inter-, cross-, trans-, and multidisciplinarity within the arts demonstrates, the hybridity of different art genres is also just as complicated.[2] The manifold interactions between pop-cultural codes, their commercial exploitation, and media-technological formatting are highlighted in Diedrich Diederichsen's essay, how they are reflected in visual art in Christian Höller's. The hybrid disposition of acoustic self-perception between the inside and outside world is the theme of Michel Chion's contribution.

This may sound like a résumé of the "new obscurity" identified by Jürgen Habermas,[3] or like the typically post-modern situation where the categorizations of scientific positivism reach their limits just like the conceptual structure of cultural theory that has developed since the Renaissance. However, in the following I shall argue that we are not dealing solely with the description of a current situation. In the thematic field of audiovisuology, it has been apparent for some time now that instead of the categorical demand for clear classification (either—or), there exists an indeterminateness (neither—nor), which is intrinsic to this phenomenon; not a deficiency, but instead an essential or genuine

1 In the Introduction to *Audiovisuology Compendium*, the paradoxes of an overall chronology of the parallel thematic strands were presented. The present Prologue focuses on the possibility or impossibility of assigning individual phenomena to a specific context and of sharply distinguishing between categories. In this sense, it functions as hinge between the two *Audiovisuology* volumes. Dieter Daniels, Sandra Naumann, eds. *See This Sound: Audiovisuology Compendium* (Cologne: Walther König, 2010), 5–16.

2 See the essay by Simon Shaw-Miller in this volume and his remarks on "Hybridity and Purity in Artforms," in Simon Shaw-Miller, *Visible Deeds of Music: Art and Music from Wagner to Cage* (New Haven: Yale University Press, 2002), 11–29.

3 Jürgen Habermas, *Die neue Unübersichtlichkeit* (Frankfurt am Main: Suhrkamp, 1985).

indetermination.[4] In the following, this will be characterized by the concept of *hybridity*, in full awareness that in this term manifold connotations from science and cultural theory converge.[5] These different meanings of hybridity match the spectrum of themes covered in this volume, because many phenomena and artefacts of audiovisuology defy univocal classification. In Bruno Latour's science studies, the hybrids (later he also refers to them as quasi-objects), "chimeras between nature and culture," take on a key role in his critique of the modern era's mania for categorization.[6] The intention here is to make this figure of thought from science studies fruitful for cultural and media theory as a leitmotif, because so far this thematic complex lacks an adequate method to deal with hybridity. Therefore, we shall turn our attention to the monsters that cannot be sorted into any species pigeonhole—the only thing is, we don't deal with life forms, but with devices.

My second proposition is that this *genuine hybridity* is based above all on the development of audiovisual devices since the eighteenth century. Thus, the analysis of image/sound relations can be classed as an exemplary case study for the entire field of art/technology relationships, and as a forerunner of issues in contemporary media art.[7] The prehistory of a correlation between sound and color reaches back to classical antiquity, and the practice of linking images and sounds can actually be recognized as an anthropological constant.[8] For centuries people sought correspondences between human perception and the physical world order by constructing analogies (or conjuring up magical ones) between the senses and the absolute. Embedded in a model of universal harmony, which in addition to color and sound also included the seasons, elements, planets, metals, and points of the compass, this was all about the "big" questions, such as the relationship between humans and nature in God's plan, purportedly reflected in a direct correspondence between the subjective intensity of the senses and the objective character of nature. Access to these holistic ideal truths was sought in very different ways, both using the mind and the senses. Pythagoras' "harmony of the spheres" or *Musurgia universalis* by Athanasius Kircher are—although they have been disproved by modern physics—mathematical models of a high order. On the other hand, mystical and ecstatic, para-religious experience, which is supposed to lead to direct intuition, is often likened to the synthesis of hearing and seeing—from prehistoric rituals to today's rave culture. Theosophical and occult theories cite references that range from Kircher to Kandinsky in their enthusiasm for synesthesia.[9] For his light-music, Alexander Scriabin planned a multi-sensory temple of mysteries,

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4 Cf. Irmela Schneider, "Hybridization follows . . . the logic of 'as well as' and not of 'either—or.' This kind of logic does not absolve one from the cognitive task of differentiating, without which insight is impossible; however, it clearly demonstrates that thinking in alternatives and opting for one or the other side is both a choice and a decision that is neither logically inevitable nor natural." Irmela Schneider, "Von der Vielsprachigkeit zur *Kunst der Hybridation*," in ibid. and Christian W. Thomsen, eds., *Hybridkultur. Medien, Netze, Künste* (Cologne: Wienand, 1997), 14–66, here 45–46.

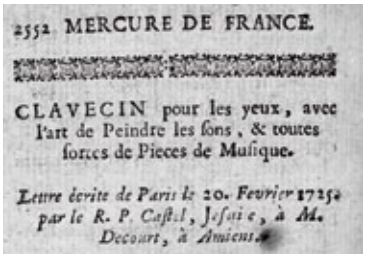
5 On the various usages of the concept of hybridity, see Schneider and Thomsen, *Hybridkultur*, 1997; Gerfried Stocker and Christine Schöpf, eds., *Hybrid: Living in Paradox. Ars Electronica 2005* (Ostfildern: Hatje Cantz, 2005).

6 Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993).

7 Gaining access to history from the present viewpoint backwards, and an extension of media art contexts are leitmotifs for the entire project of "See this Sound," including the accompanying exhibition; see Dieter Daniels and Stella Rollig, "Preface," in *See This Sound: Promises in Sound and Vision*, eds. Cosima Rainer, Stella Rollig, Dieter Daniels, and Manuela Ammer (Cologne: Walther König, 2009), 10–13, here 12.

8 Cf. Dieter Daniels and Sandra Naumann, "Introduction," in Daniels and Naumann, *Audiovisuology Compendium*, 6.

9 Cf. Andrea Gottdang, "Painting and Music," in Daniels and Naumann, *Audiovisuology Compendium*, 246–257, here 251.


2552 MERCURE DE FRANCE.

CLAVECIN pour les yeux, avec l'art de Peindre les ſons, & toutes ſortes de Pieces de Muſique.

Lettre écrite de Paris le 20. Fevrier 1725. par le R. P. Caſtel, Jeſuite, à M. Decourt, à Amiens.

– Title page of the essay "Clavecin pour les yeux, avec l'art de Peindre les sons, & toutes sortes de Pièces de Musique" by Louis-Bertrand Castel, *Mercure de France* (November 1725), 2552–2577.

which was never realized. Comparable knowledge about the world was promised by the combination of drug-induced experience and the psychedelic light show environments of the 1960s.[10] Without such a metaphysical superstructure, the interactive immersion in computer games or in performances of live visuals connects sensorimotor activity with audiovisual perception to produce a synesthetic experience of presence.

Case Study Hybrid Artefacts: Aesthetic Evidence versus Physical Experiment—Castel and Chladni

In the Age of Enlightenment a new chapter began for this long history of color/sound correspondences. Almost all publications on this subject mention the French Jesuit, mathematician, physician, and philosopher Louis-Bertrand Castel as a prominent forerunner of present-day developments. And indeed, a few important innovations are found in Castel's works:[11]

— For the first time, a theory is formulated which refers exclusively to color/sound analogies, and is no longer embedded in a holistic model for explaining the world.
— For the first time, the attempt is made to bring the mind and the senses into consonance. Castel's model aspires to be mathematically, physically, and aesthetically compelling.
— For the first time, a device is proposed that could serve as proof of the theory, and as its practical application.

The role assigned to the device known as the *clavecin oculaire* (ocular harpsichord) was key; if it worked, Castel's hypotheses would be confirmed scientifically and rationally, as well as intuitively and sensually. To get straight to the point: the ocular harpsichord, originally conceived by Castel as a thought experiment, apparently never worked properly. Despite the extensive debates that surrounded this device, no eye or ear witness accounts of a successful presentation exist. Wisely, at first Castel was against constructing such an apparatus: he said that he spoke only as a philosopher, not as a craftsman.[12] However, the great public interest and the criticism of prominent contemporaries, such as Diderot, Voltaire, and Rousseau, made him feel obliged to provide experimental proof of his controversial hypotheses.

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10 These mystical experiences of true insights, however, tend not to be sustainable; see Arthur Koestler's comment on drug-induced experiences to Timothy Leary: "I solved the secret of the universe last night, but this morning I forgot what it was." Timothy Leary, *Flashbacks: An Autobiography* (Los Angeles: Tarcher, 1983), 61.

11 See Jörg Jewanski, "Louis-Bertrand Castel. The Clavecin oculaire (after 1723)," in Daniels and Naumann, *Audiovisuology Compendium*, 83.

12 Jörg Jewanski, *Ist C = Rot? Eine Kultur- und Wissenschaftsgeschichte zum Problem der wechselseitigen Beziehung zwischen Ton und Farbe. Von Aristoteles bis Goethe* (Sinzig: Studio, 1999), 283.

In the Age of Enlightenment, a hypothesis had to be tested and proved through an experiment or demonstration, as Diderot demanded in his *Encyclopédie* with regard to the effect that Castel ascribed to the ocular harpsichord: "Only direct experience can decide this matter."[13] However, despite 30 years of frantic *bricolage*, the controversial theorist did not succeed in becoming a practitioner of color music. In his fruitless efforts to make his natural-philosophical idea an empirical and technological reality, Castel increasingly became the victim of his own invention.[14] Moreover, it was not possible to prove the correctness of his table of color/sound correspondences or indeed any of the experiments by other researchers, which ultimately cancelled each other out because of their diversity.[15] In this way, Castel also became the precursor of a leitmotif, which runs through the entire history of ocular harpsichords and all later artistic and technological experiments to visualize music: failure due to the lack of compatibility between physical reality, theoretical insight, aesthetic vision, and technical feasibility.

Castel's paradox lies in the fact that although he takes science as a starting point, especially Isaac Newton's *Opticks*, he does not formulate a clearly defined rationale. The possible applications of his thought experiment seem to fascinate him more than the proof of which colors correspond to which sounds. This is already clear in the title of Castel's first publication from 1725 and the sketches of motifs for his invention which it included: practical, philanthropical uses (deaf people could enjoy music through seeing it, blind people could perceive colors through sound), educational use (schooling painters in the harmony and dissonance of colors), its creative potential (a new instrument for the painting layperson, who could effortlessly create thousands of pictures), and finally purely aesthetic reasons (from capturing the fleetingness of music so it can be analyzed at leisure with the eye, to decorating a space with a *tapisserie harmonique*, which allows visual enjoyment of an entire piece of music).[16] Castel prophesied that his ocular harpsichord would one day be as popular as traditional musical instruments, and in Paris alone he expected to sell 800,000 of them.[17] Whether his apparatus is a scientific experiment, an instrument for a new form of art, a medical prosthesis, a device for entertainment, or the prototype for a new branch of industry, is ultimately undecidable.[18]

Castel's approach is a crude mixture of physics, philosophy, physiology, aesthetics, and relics of theology. His ocular harpsichord was supposed to prove physics through aesthetics; that is, the analogy of the materiality of light and sound was to be explained through human perception of them. This indicates that, ultimately, Castel stands in the tradition of the holistic world harmony models, from Pythagoras to Kircher. From the point of view of science in the age of empiricism, experiment, and enlightenment, this way of thinking in

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13 Denis Diderot 1753, cited in Jewanski, *Ist C = Rot?*, 365.

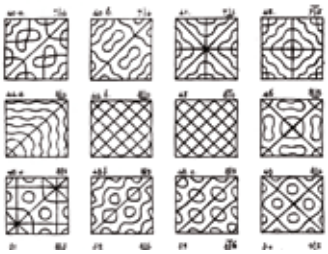
14 Cf. Maarten Franssen: "A picture emerges of a man gradually worn out completely by his own invention, although he kept believing in it to the last." Maarten Franssen, "The Ocular Harpsichord of Louis-Bertrand Castel: The Science and Aesthetics of an Eighteenth-century cause célèbre," in: *Tractrix. Yearbook for the History of Science, Medicine, Technology and Mathematics*, 3, 1991, 15–77, here 28.

15 See the table by Jörg Jewanski in Daniels and Naumann, *Audiovisuology Compendium*, 345.

16 Louis-Bertand Castel, "Clavecin pour les yeux, avec l'art de Peindre les sons, & toutes sortes de Pièces de Musique," in *Mercure de France*, November 1725, 2552–2577.

17 Barbara Kienscherf, *Das Auge hört mit: Die Idee der Farblichtmusik und ihre Problematik—beispielhaft dargestellt an Werken von Alexander Skrjabin und Arnold Schönberg* (Frankfurt am Main: Peter Lang, 1996), 37.

18 For a viewpoint from science historians ("whether the ocular harpsichord was a scientific instrument or not, depends on one's point of view") see Thomas L. Hankins and Robert J. Silverman, *Instruments and the Imagination* (Princeton: Princeton University Press, 1999), 74.



– Sound patterns (1787) by Ernst Florens Friedrich Chladni. Source: Ernst Florens Friedrich Chladni, *Entdeckungen über die Theorie des Klanges* (Leipzig 1787), 115, plate X.

analogies appears totally antiquated.[19] However, from the retrospective point of view of cultural history, the futuristic aspects of Castel's ideas become apparent, and can today be read as a kind of science fiction.

The sound figures that were generated and described in 1782 by Ernst Florens Friedrich Chladni are a counter-example to Castel's ocular harpsichord. In his experiments, sound was used to excite fine sand sprinkled on thin plates, which visualized the vibrations as exquisite patterns and lines and permitted visual analysis of the oscillations. The patterns were no longer based on speculative analogies, but represented an objective correspondence between acoustic and optical phenomena. From these premises Chladni, who was born one year before Castel died, developed the physical basis of acoustics. His starting point was clearly scientific: the oscillation of strings could already be calculated, so Chladni wanted to explore the "true complexion of the sound of such bodies, in which the elastic bending of whole surfaces in several dimensions at once come into question."[20] The aesthetic fascination of the sound figures contributed significantly to the success of Chladni's copiously illustrated books. He also suggested using the figures to enrich the repertoire of patterns used in the cloth and wallpaper manufacturing industries.[21] From 1789, Chladni also used his discoveries to invent two new kinds of musical instruments, the Euphon and the Clavicylinder, which especially enabled him to improve his precarious financial situation. He demonstrated the instruments himself in numerous concerts, at which he also demonstrated the sound figures.[22]

Both Chladni and Castel are part of a hybrid praxis. As authors and actors they stand in their contemporary context between the realms of science, aesthetics, invention of devices, and entertainment. Their linking of science and art, however, took place from reversed directions. Whereas Castel wanted to prove a physically inexplicable analogy of color spectrum and musical scale via aesthetic evidence, Chladni analyzed in his experiments the physical structure of sound waves in solid bodies, and from this early form of scientific visualization, he derived scientifically valid experiments as well as artistic and entertaining results. This casts Castel as a forerunner of the understanding and misunderstanding of *art as science*, and Chladni, vice versa, as a forerunner of the equally problematic *science as art*.

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19 On Castel's theological rhetorics of analogy, see: Hankins and Silverman, *Instruments and the Imagination*, 80ff.

20 Ernst Florens Friedrich Chladni, *Entdeckungen über die Theorie des Klanges*, Leipzig 1787, 1.

21 See the work description of Chladni's figures by Birgit Schneider in this volume.

22 "The proceeds from his lecture tours and his works had to provide the means for his upkeep and for his experiments." Eugen Lommel in *Allgemeine Deutsche Biographie*, published by the Historische Kommission bei der Bayerischen Akademie der Wissenschaften, vol. 4, 1876, 125; see also: Dieter Ullmann, "Life and work of E.F.F. Chladni," in *The European Physics Journal*, Special Topics, 145, 2007, 25–32, online: http://www.springerlink.com/content/fx2jm482p0404q33/fulltext.pdf.

The interesting thing about Castel is not his misguided theory or his non-functioning apparatus, but instead his attempt to link theory, sense perception, and device. From this point onwards, the history of correspondences of the visual and the auditive also becomes a history of technology.[23] Through technology, the relation between optics and acoustics is no longer restricted to the color/sound analogy; but the representation of its physical nature, its morphology so to speak, achieves far wider dimensions. Dimensions with respect to instruments and devices as well as scientific and aesthetic ones—this became apparent for the first time with Chladni's figures. In 1802, Chladni's contemporary Thomas Young succeeded in demonstrating the wave form of light. This laid the physical foundation for the development of audiovisual media technology in the nineteenth century, and at the same time eliminated the basis for the centuries-old quest to discover analogies in the phenomena themselves.

Up to this point in history, the suspected analogy between the natural phenomena of sound and light was based on the purely subjective experience of a relation between hearing and seeing, as well as on holistic models of world harmony. After Castel and Chladni, images and sounds were also coupled through devices and experiments created by humans. On the one hand this coupling is objective, because it is technical and physical, and on the other it is subjective, because it is manipulable and controllable. This marks a new era in the linking of image and sound, which extends from the development of optical and acoustic media in the nineteenth century to contemporary universal possibilities to modulate, generate, and transform the audiovisual by digital means.

Aesthetic, Epistemic, Pragmatic, and Entertaining Devices

The hybridity of science, art, entertainment, and commerce outlined here can also be demonstrated specifically for the development of media technology. This not only concerns the heterogeneous motivations for and contexts of current inventions, but also the hybridization of the optical and acoustic processes, whose development continues through combinations and permutations of their functional principles.

The findings of basic research in physics and physiology since the beginning of the nineteenth century (including work by Chladni, Young, and especially Hermann von Helmholtz's extensive studies of physiology, optics, and acoustics) began to be utilized in the second half of the nineteenth century in specific apparatuses and media. The epistemic device of the laboratory experiment, which was originally constructed for research purposes, was translated into media-technological applications suitable for everyday use that gave rise to an audiovisual mass culture of pragmatic and entertaining devices.[24] Initially the technological media separated the visual from the auditive. Silent films, the gramophone, telephone, and early ideas for television all specialized in the technological emulation of just one human sense faculty.

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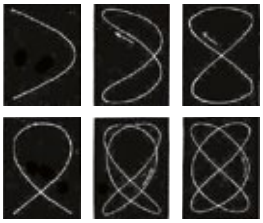
23 The music machines of the Baroque age can be regarded as precursors, for they comprised both sound and moving figures, although they were also models for possible early industrial production techniques: cf. Salomon de Caus, *Von gewaltsamen Bewegungen: Beschreibung etlicher, so wol nützlichen alß lustigen Machiner* (Halle: Stekovics, 2003), reprint of the Frankfurt edition of 1615.

24 See in this context Hans-Jörg Rheinberger's concept of "epistemic things," which are based on available technology, but in the context of experimental systems can also transcend it and interrogate the basis of their own development; Hans-Jörg Rheinberger, *Toward a History of Epistemic Things: Synthesizing Proteins in the Test Tube* (Palo Alto: Stanford University Press, 1997).



– Lissajous figures for various frequency ratios, in different stages of their cycles. From *Koenig's Acoustic Catalogue*, 1865. Source: Case Western Reserve University, Collection of Antique Physics Instruments.
– Vibration microscope for the observation of Lissajous figures (c. 1860) by Hermann von Helmholtz, model from *Koenig's Acoustic Catalogue*, 1865. Source: Case Western Reserve University, Collection of Antique Physics Instruments.

However, both the history of the ideas and the operating principles of the optical and acoustic media were engaged in an ongoing dialogue. The invention of the telephone by Alexander Graham Bell in 1876 supplied the inspiration for Thomas Alva Edison's Phonograph, and also led to plans for electronic transmission of images because of the photo-electric sensitivity of selenium, which was known since 1872. Basic concepts for the medium of television were formulated around 1878 and envisaged the transmission of signals live via wires; however, this could not be realized due to the state of technology at the time. The parallels between sound and image technologies were also evidenced by Edison's prototype for the Kinetoscope of 1888, which was nothing but a Phonograph fitted with chronophotographic images.[25] The formulation in the patent, "to develop an instrument, which does for the eye what the Phonograph does for the ear," can be taken quite literally.[26]

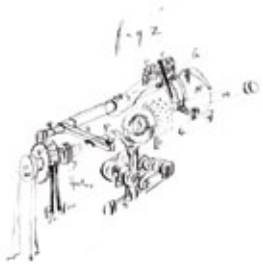
The history of ideas for the transmission medium television and the storage medium of film operate in the gap which had developed between image and sound as a result of photography, telephony, and the Phonograph: if still images and time-based sounds can be stored—and sounds can be transmitted electronically—why shouldn't it be possible to transmit and store moving images, too? Ever since, such conclusions by analogy between acoustic and optical media have characterized the development of radio, television, and sound film as well as the audio-video synthesizer. This is why it is wrong to reduce the parallel histories of each of the audiovisual media to separate lines of development for images and sound. Rather, they should be understood as a complex interaction, which already contains the potential for its multimedia synthesis.
The prehistory of this development of optical and acoustic media devices that keep intersecting, is found in Hermann von Helmholtz's research in optics and acoustics. "This back and forth comparing the models of the two sensory systems" led him to the first comprehensive theory that relates the physical characteristics of light and sound to the physiological faculties of sight and hearing.[27] The laboratory instruments that Helmholtz developed played a key role in this.

Helmholtz modified a telegraph constructed by his friend Werner Siemens and around 1860 the vibration microscope was created. The instrument visualizes

25 In 1878, Edison was already thinking about connecting the playback of images and sound, though it was not until he encountered Eadweard Muybridge and his Zoopraxiscope in 1888 that Edison's assistant William Dickson modified a phonograph by adding 42,000 pictures and the ocular of a microscope, and transformed it into an image machine; see Neil Baldwin, *Edison: Inventing the Century* (New York: Hyperion, 1995), 211–212.

26 See Jan Philip Müller, "Synchronization as a Sound/Image Relationship," in Daniels and Naumann, *Audiovisuology Compendium*, 400–413.

27 Cf. Timothy Lenoir, "Farbensehen, Tonempfindung und der Telegraph: Helmholtz und die Materialität der Kommunikation," in Hans-Jörg Rheinberger and Michael Hagner, eds., *Die Experimentalisierung des Lebens* (Berlin: Akademie Verlag, 1993), 62.



– Sketch for the cylinder of the Peephole Kinetoscope (c. 1888) by Thomas Alva Edison. Source: The Thomas Edison Papers, Rutgers, The State University of New Jersey, Patent Series, Caveat Files: Case 110: Motion Pictures (1888) PT031AAA1; TAEM 113:238.
– *Pyrophone* (1875) by Frédéric Kastner, played by Wendelin Weissheimer. Source: Harald Szeemann, ed., *Der Hang zum Gesamtkunstwerk* (Aarau 1983), 199.

sound in the form of overlapping Lissajous figures. Experimental method and the formation of theory proceed by constantly comparing auditory and visual perception.

Through the vibration microscope various small phase differences of the partials of more complex sounds become visible, although they do not influence the tone color very much, as Helmholtz was able to demonstrate. This discovery motivated him to work on developing Young's color theory, according to which color vision develops through comparable principles; namely, the reception of varying degrees of intensity within the spectral range of light.[28] This experiment led Helmholtz to a theory that takes into account what the perception processes have in common, but also the differences between neuronal receptors in the eye and the ear.[29] The theory demonstrates scientifically why a direct analogy of color shades and sound colors is not possible. The eye can perceive a mixture of colors only as a single color shade, whereas the ear can differentiate between the spectral components of a sound.[30]

Helmholtz's vibration microscope not only linked visual and acoustic perception, it was also a hybrid of science and media technology: an epistemic laboratory instrument, which was based on the pragmatic telegraphy device by Siemens, contained the functional principles of telephone and Phonograph already fifteen years before the inventions by Bell and Edison. Helmholtz's research was continued in 1873 by Emil Du Bois-Reymond who exchanged optic and auditory nerves in a physiological thought experiment that also inspired many artist-inventors.[31]

The hybridity of art, technology, science, and entertainment can be demonstrated in many examples from the history of technology. One example is the history of the origins of film, which culminates in the first public film shows in Paris and Berlin in 1895, and earlier at the World Exhibition in Chicago in 1893.[32] These parallel inventions all have an individual prehistory: advances in the photographic industry (*cinématographe* by the brothers Auguste and Louis Lumière),

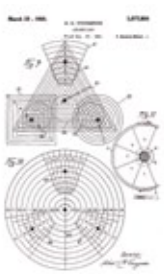
28 Thanks to Jan Thoben for his support in differentiating the argument on Helmholtz.

29 "Through this the qualitative differences in the visual impressions are attributed to the various receiving nerves. Then there remains only the quantitative differences of stronger or weaker excitation for the impressions of each optic nerve fiber. The same is accomplished by the hypothesis for hearing, which was the result of our study of tone color." Helmholtz cited in Lenoir, "Farbensehen, Tonempfindung und der Telegraph," 64.

30 Helmholtz summarized by Timothy Lenoir: "The eye does not know any kind of music, because it only possesses three instead of the 1000 'resonator' types of Corti's membrane." Lenoir, "Farbensehen, Tonempfindung und der Telegraph," 64. On the superceding of Helmholtz's quantitative model by neurobiology, see the essay by Chris Salter in this volume.

31 On Emil Du Bois-Reymond, see the essay by Birgit Schneider in this volume.

32 On the numerous parallel inventions see: http://www.victorian-cinema.net/machines.htm.



– Alexander Wallace Rimington's Color-Organ (1895).Source: Adrian Bernard Klein, *Colour Music, The Art of Light* (London 1926), plate 11.
– Page from patent for the Chromopiano (1921/1926) by Arthur C. Vinageras. Source: United States Patent US1577854, http://www.freepatentsonline.com/.

new approaches to mass entertainment (the Bioscope of the showmen brothers Max and Emil Skladanowsky in Berlin), and transfer of sound storage to the moving image (Kinetoscope by Thomas Alva Edison).

Science provides the foundations for media technology and, in turn, technological innovations trigger scientific debates. An example of this is the Phonograph, which Edison invented in 1877, at first without assigning it a specific function. Edison publicized its unlimited possibilities and made great efforts to demonstrate this with numerous examples. Amongst these uses were: singing children to sleep, recording the last words of famous men, distributing audio books in editions of millions, playing musical compositions backwards or slower or faster, and, half-jokingly, recording men's vows of love, so that the women they cheated on could play this back again to the philanderers.[33] However, the Phonograph was initially an epistemic device, whose epistemological implications made its inventor world-famous. Numerous reactions to it in the USA, and even more in Europe, can be summarized in one question: when a device de facto demonstrates what had previously been considered impossible according to the world view of Aristotelian physics—namely, that the flow of time could be stored, and could actually be played backwards—does this mean that future progress in science, in philosophy, as well as in physiology and physics, can now only be achieved via technology? Analogies were made with the functioning of human memory as hitherto the only storage medium for time. " Is the brain a Phonograph?" was a question that was seriously discussed.[34] It took over 20 years before Edison was able to develop a commercial model of the Phonograph from the patent.

The Pyrophone by physicist Frédéric Kastner was a comparable example of an invention that was based primarily on aesthetic and philosophical motives, presented to the public for the first time in 1873. Like the Phonograph, it was based on physical phenomena that had been known for some time. Colored gas flames simultaneously generated the light and sound, utilizing the effect of the so-called "singing flames," which Bryan Higgins had discovered by chance in 1777 and which were also researched by Chladni. The Pyrophone is a hybrid of music and physics, of art and experiment. Henry Dunant, the philanthropic visionary and founder of the Red Cross, who was financially supported by Kastner's mother, provided the natural-philosophical imagery for it, very much in the tradition of the holistic world models of previous centuries. For the parallel generation of sound and light, Dunant employed the metaphors of *harmonica*

33 Cf. Edison's article of 1878, cited in Baldwin, *Edison*, 403.

34 Baldwin, *Edison*, 439. On the phonograph as inspiration for the science fiction of an avatar in Auguste de Villiers de L'Isle-Adam's novel *Tomorrow's Eve*, see Dieter Daniels, *Kunst als Sendung: Von der Telegrafie zum Internet* (Munich: C. H. Beck, 2002), 68–75.

chimique and *lumen philosophicum*,[35] which are evocative of alchemy. Through Dunant's numerous lectures, the Pyrophone also aroused Richard Wagner's interest, who viewed it as a felicitous technical realization of his idea of the *Gesamtkunstwerk* and wanted to use it in his operas. However, the bankruptcy by Wagner's patron, King Ludwig II. of Bavaria, prevented the realization of these plans.

As the example of the Pyrophone shows, the history of media technology outlined above is accompanied by a parallel history of visual and auditory devices by artist-inventors, most of which have been lost today. In the eighteenth century, subsequent to Castel, several color organs were designed, although there is no evidence that they were successfully realized. Then, from the mid-nineteenth century on, there was a long succession of devices for which their inventors created new names—W. F. Philippy: Farbenklavier (1863); Bainbridge Bishop: Color Organ (1876); A. Wallace Rimington: Mobile Color (1895); James M. Loring: Musical Chromoscope (1900); Alexander Burnett Hector: Apparatus for Producing Color Music (1912); Vladimir Baranoff-Rossiné: Piano Optophonique (1916); Mary Hallock-Greenewalt: Sarabet (1918); Thomas Wilfred: Clavilux (1919); Arthur C. Vinageras: Chromopiano (1922/1926); Ludwig Hirschfeld-Mack: Farben Licht-Spiel (1922); Raoul Hausmann: Optophon (1922); Alexander László: Sonchromatoscope (1925); Zdeněk Pešánek: Spectrofon (1926); Baron Anatol Vietinghoff-Scheel: Chromatophon (around 1930).

Most of these devices were actually built and presented, but some were only described or patented, though a few were even manufactured in small series. The majority demonstrated color/sound analogies, some were also for playing free-ranging image/sound compositions, and others just produced silent visual music. Technologically the devices differed considerably, but were mostly a combination of mechanical and electrical parts. Because of these technical differences, the history of ideas that went into the instruments takes precedence over their place in the history of technology. Paradoxically, this history of ideas is not a continuous genealogy, but a story of multiple reinventions because the authors rarely knew of each other's existence.[36]

Almost all of the artist-inventors expected a great future for their creations, which were considered suitable for mass production and distribution, as had been Castel's intention.[37] These hybrids between instrument, work of art, and media device, however, all shared a similar fate: they were dead ends. The complicated apparatuses could only show their creators' compositions, and not one established itself as a standard instrument. These artefacts are the complete opposite of universal machines: highly specialized, individualistic devices, which therefore—metaphorically speaking—die together with their inventors and are forgotten. None of the artist-inventors succeeded in getting his invention used, cared for, or developed by his successors, so that today only a few working examples of such machines still exist. This proves the importance of standardization and compatibility for the distribution and conservation of audiovisual media, for which the 35-mm film, as the longest-living global media format, is the best example.

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35 [Henry] Dunant, "The Pyrophone," in *The Popular Science Monthly*, August 1875, 444–453, here 445. On Dunant and Kastner see Harald Szeemann, ed., *Der Hang zum Gesamtkunstwerk* (Aarau: Sauerländer, 1983), 198.

36 See Daniels and Naumann, "Introduction," 6.

37 Thomas Wilfred was one of the few who managed to sell a small series of sixteen models of his Clavilux Junior (1930) for home use; see Yale University Library: http://images.library.yale.edu/madid/oneItem.aspx?saveID=1776789&id=1776789.

The parallel development of audiovisual devices within the contexts of scientific experiments, industrial media technology, innovative art, and broad-impact mass entertainment illustrated here using individual cases, is the basis for the suggestion to describe them as epistemic, pragmatic, aesthetic, and entertaining devices.[38] What are the criteria for differentiation, though? Let us go back to the comparisons mentioned above. From today's perspective, the distinction seems to be clear: Chladni's figures are treated as a pioneering achievement in acoustics by the history of science, whereas Castel's ocular harpsichord is relegated to the curiosities. Kastner's Pyrophone has been largely forgotten, whereas Edison's Phonograph is mentioned in every history of technology.[39]

Still, the motto of Chladni's 1787 *Discoveries Concerning the Theory of Sound* is "the art of painting with sounds," a quotation from the poet Christoph Martin Wieland. And to which category should the Phonoautograph be assigned, the first machine for the time-based visual display of sound on a paper strip, patented in 1857 by Édouard-Léon Scott de Martinville, who had no idea that these graphical traces of sounds were capable of being played back—something that digital technology only made possible in 2008? The imaginative potential unleashed by a system for two-way electrical transformation of picture and sound signals is evidenced by the proposals of Maximilian Pleßner in 1892 for hypothetical uses of future television technology that ranged from the artistic, aesthetic, and analytical to the practical.[40] Let us expand the perspective to include the present day, where the situation is even more opaque: the recording principle of the Phonograph is taken by DJs in turntablism as a creative technique for manipulating sound, not for reproducing it, which is why vinyl records have survived into the digital age. And in the plasma tweeters of hi-fi technology, the singing flames are used for the perfect reproduction instead of the creation of music.

Issues of Method: Hybrid Identity, or Lost in Interdisciplinarity

But isn't all this a misleading methodic mix-up? Is it legitimate to measure the actual function of a device against the inventor's or constructor's intentions? Shouldn't the history of ideas be treated separately from the history of devices? The technological artefacts themselves do not carry a telos within them; the same functional principles can be used for very different purposes. In this respect the motives of the inventors cannot represent criteria for the success or failure of the artefact. Nevertheless, the history of ideas decisively influences the actual implementation of technologies and their real applications.

We are now approaching an issue of methodology, for which Bruno Latour coined the term "pragmatogony" to mean a mythical genealogy of the objects. Pragmatogony describes an indissoluble, iterative interaction of social processes and technological artefacts through which, according to Latour, the dualism of

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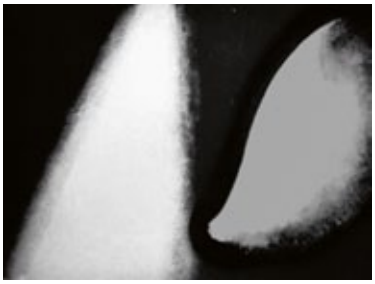
38 On the distinction between pragmatic and aesthetic devices see: Dieter Daniels, "Sound & Vision in Avant-garde & Mainstream," in Rudolf Frieling and Dieter Daniels, eds., *Media Art Net 2: Key Topics* (Vienna and New York: Springer, 2005), 59–87; online: http://www.medienkunstnetz.de/themes/image-sound_relations/sound_vision/.

39 On the hybridity of Pyrophony between science, art, and spectacle see Helmar Schramm, "Pyrophonie: Anmerkungen zur Theatralität des Experimentierens," in Helmar Schramm, Ludger Schwarte, and Jan Lazardzig, eds., *Spektakuläre Experimente: Praktiken der Evidenzproduktion im 17. Jahrhundert*, Theatrum scientiarum, vol. 3 (Berlin, New York: Gruyter, 2006), 398–413.

40 See Birgit Schneider's description of Maximilian Pleßner's brochure "Die Zukunft des elektrischen Fernsehens" of 1892 in this volume.



– Still from the reconstructed color version of Walter Ruttmann's *Lichtspiel opus 1* (1921). © Eva Riehl, courtesy Filmmuseum München.
– Page from the patent "Procedure and device for production of cinematographic images" (1920) by Walter Ruttmann, with three movable glass screens for the wet paint (c, d, e), three illumination lamps (a), and the camera (b). Source: Jeanpaul Goergen, *Walter Ruttmann. Eine Dokumentation* (Berlin 1989), 77.

technology and society is as impossible to uphold as the strict separation of culture and nature, already sublated in Latour's term "hybrids." "But techniques are not fetishes, they are unpredictable, not means but mediators, means and ends at the same time; and that is why they bear upon the social fabric."[41] Pragmatogony is intended to provide an alternative to the myth of progress; the development of a field of knowledge that is demanded here through parallel consideration of diachronic and synchronous depiction applies equally to the thematic field of audiovisuology. Depending on the perspectives and case studies selected, the history of acoustic and optical devices can be portrayed either as permanent progress or as constant failure.

In its overall approach, audiovisuology aims to render the range of topics at least halfway representable, despite the impossibility of constructing an extensive chronology or methodology. Therefore, it is necessary that the disciplines involved form a principled multi-perspectivity together, which has become especially obvious in the chronological descriptions of individual phenomena in the *Audiovisuology Compendium*. The thematic cross-sections in this second volume present the plurality of methods that can be applied. As explained in the Introductions to the two volumes, there is no chronology or method that can claim any form of general validity. Further, the genuine hybridity of the object of research, mentioned at the beginning of this Prologue, cannot be entirely resolved through scholarship.[42]

The indissolubility of this hybridity is also the main reason for what one could describe as being lost in interdisciplinarity. On one side, this concerns the cultural and scientific evaluation of individual phenomena (artworks, devices, theories), which, depending on their location within an art genre (music, painting, sculpture, film, and so on), in media technology, or in science, are subject to entirely different evaluation criteria. It also concerns the absence of an audiovisual historiography and, therefore, the handing down of knowledge and the formation of cultural and intellectual traditions. This is the reason why many color organ inventors believed that they were the first to have the idea of linking hearing and seeing in an apparatus.[43]

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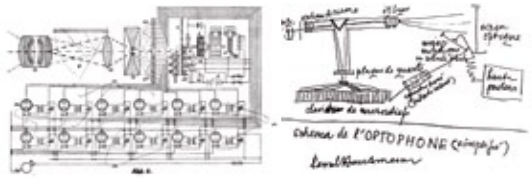
41 Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999), 197.

42 This is the reason, why *genuine hybridity* also resists the holistic world harmony models and the universalism of a *Gesamtkunstwerk*; see: Hans Ulrich Reck, "Entgrenzung und Vermischung: Hybridkultur als Kunst der Philosophie," in Schneider and Thomsen, *Hybridkultur*, 91–117, here 91. "Hybrid culture means the linking of contexts and areas that were originally separate into something new, which precisely does not have the effect of dissolving the elements in a synesthetically closed *Gesamtkunstwerk*, but in its aspects of divisions reveals an arrangement that is still recognizable, that represents the *dispositif* of a montage, and whose effect cannot be broken down into these parts."

43 Cf. Daniels and Naumann, "Introduction," 6.



– Circuitry for an electric apparatus generating sound frequencies from colored light (1931) by Walter Brinkmann. Source: Walter Brinkmann, "Spektralfarben und Tonqualitäten," in Georg Anschütz, ed., *Farbe-Ton-Forschungen, Vol. 3* (Hamburg 1931), 358.
– Sketch of the 1919 version of the Optophone by Raoul Hausmann, made in the 1930s. Source: Leonardo 34, no 3 (2001), 218.

Case Study: Socio-Technological Networks. Absolute Film, Radiophonic Art, Electrical Engineering, Anthropology, and Synesthesia Research in the 1920s in Germany

With the onset of the twentieth century, the hybrid phenomena, which we have investigated so far using examples from the eighteenth and nineteenth centuries, became integrated in an increasingly dense set of relationships. We are now no longer confronted with a solitary protagonist among the scientists, inventors, and artists, instead, the motif of linking and transforming the visual and the auditive runs through a wide spectrum of heterogeneous contexts. This change created socio-technological networks, which according to Bruno Latour evade being pinned down by the separated academic disciplines; however, the effects of these networks are real and considerable. An example is the situation in 1920s Germany: absolute film can be viewed as the end and dissolution of the history of color organs, in that for many artists the medium of film superceded creating their very own devices. The cinematographic apparatus was modified, for example, by Walter Ruttmann and Oskar Fischinger to meet the needs of their abstract films, so the history of the artist-inventors continued into the medium of film. In parallel, radiophonic art was being developed for the new medium of radio. The interaction between the aesthetics of *silent* movies and *blind* radio is demonstrated paradigmatically in Kurt Weill's theory of a non-narrative, acoustically abstract "absolute radio art," which he formulated in 1925 with direct reference to absolute film. His intention was to "think through to the end the often used and far too often misused comparison of film and radio-broadcasting once and for all."[44] The most famous example of radiophonic art, however, was by Walter Ruttmann, pioneer of the absolute film: in 1930, Ruttmann produced the audiomontage *Weekend*, commissioned by German Radio Broadcasting, using the Tri-Ergon process developed in Germany in the 1920s, which inscribes sound as a light track on the edge of film stock. This process was the first to store sound and image together on the same medium. The technology was intended for synchronization, but could also be used for artistic experiments in which visuals were transformed into acoustics. For the first time, it enabled a free synthesis of sounds, as well as a direct analogy between optical and acoustic perception. It was explored by Oskar Fischinger from the perspective of film art, from the vantage point of an engineer by Rudolf Pfenninger through experiments in synthetic sound.[45]

The complex web of partially parallel, partially related developments of a socio-technological network outlined here, is also embodied in exemplary

44 Kurt Weill "Möglichkeiten absoluter Radiokunst," in idem., *Musik und Theater: Gesammelte Schriften*, eds. Stephen Hinton and Jürgen Schebera (Berlin: Henschel, 1990), 192.

45 Cf. Thomas Y. Levin, "'Tones from out of Nowhere': Rudolph Pfenninger and the Archaeology of Synthetic Sound," in *Grey Room* 12 (2003), 32–79.

– Generation of sound patterns of classical music on the screen of a Nipkow television system (1930) by Fritz Wilhelm Winckel.
Source: Fritz Wilhelm Winckel, "Vergleichende Analyse der Ton-Bild-Modulation," in *Fernsehen*, no. 4 (Berlin 1930), 171–175, here 173.

individual hybrid objects. A particularly incisive case is the Optophone. This device was developed in the 1910s to enable blind people to "see"—a photoelectric cell converted different light intensities, printed letters for example, into a series of sounds. In the 1920s the Dada artist Raoul Hausmann developed "Optophonetics" as a new form of art. He designed an appropriate device that, when played as a live-instrument, would simultaneously produce images and sounds, extending the artist's sound poetry into a further medium. Hausmann's highly-detailed technical concepts were based on extensive research in physiology and electrical engineering and led to an initially unsuccessful application for a patent.[46] Through his collaboration with the radio and electronics engineer Daniel Broido, Hausmann's synesthesia device transmuted into an optical-mechanical calculating machine, which could be used to calculate the price of a train ticket, for example, as stated in the new patent specification that was granted in England in 1936.[47] It is highly doubtful whether Hausmann ever actually built an Optophone. Therefore, with regard to the multiplicity of its possible contexts and uses, the Optophone is a worthy successor to Castel's ocular harpsichord: both devices probably never existed as functioning machines, but nevertheless sparked extensive debate.

Thus in 1927 the Bauhaus artist László Moholy-Nagy and the engineer Walter Brinkmann, whom he quoted at length, both refer to the Optophone.[48] Expressly dissociating themselves from the color/sound analogies put forward since Castel, they proposed to develop "scientifically based Optophonetics" by using electrical waves as the carriers of both light and sound. At the experimental radio workshop of the Musikhochschule in Berlin, Brinkmann developed a device for "converting colored light effects . . . into audio-frequency electrical oscillations with the object of producing musical sounds."[49] The goal is to find "a basis for creating synesthetic art," and thus to achieve "an approximate agreement between empirically derived findings and artistic interests as the precondition for a real color/sound art that will matter to a great number of people."[50] In 1930 Fritz Wilhelm Winckel, a student of telecommunications and acoustics, engaged with related issues in the private laboratory of Dénes von Mihály. Winckel's research was no longer based on the photoelectric cell but on the new technology of television. The results of his experiments feeding electrical acoustic signals into the new image medium were similar to Chladni's sound figures. However, his fascination with these figures motivated Winckel to pro-

46 For a more detailed depiction of the Optophone and "the multi-layered, often contradictory concepts in art, technology, and science," see the essay by Birgit Schneider in this volume.

47 Cf. Cornelius Borck, "Blindness, Seeing and Envisioning Prosthesis: The Optophone between Science, Technology and Art," in Dieter Daniels and Barbara U. Schmidt, *Artists as Inventors—Inventors as Artists* (Ostfildern: Hatje Cantz, 2008), 109–129.

48 László Moholy-Nagy, *Malerei, Fotografie, Film*, Bauhausbücher vol. 8 (Mainz and Berlin: Mann, 1967), reprint of the 1927 edition, 20–21.

49 Walter Brinkmann, "Spektralfarben und Tonqualitäten," in Georg Anschütz, ed., *Farbe-Ton-Forschungen*, vol. 3, (Hamburg: Psychologisch-ästhetische Forschungsgesellschaft, 1931), 355–365, here 355.

50 Ibid., 361.

pose a hypothesis about the objectification of beauty through the "synthesis of art by electrical means,"[51] which stated that "the individual character of an artwork is contained in the modulation curve."[52] Such theories of a new aesthetic by technicians may sound bizarre, but they were not without their counterparts in the field of contemporary humanities.

From the viewpoint of his "philosophical anthropology," Helmuth Plessner developed a theory of "the unity of the senses" to relate in a more associative way the "conceptions, ways of seeing and feeling of one art genre to those of a different art genre."[53] The counterpart to Plessner's subtle reflections on the philosophical positioning of the human race and the special place it occupies among living creatures, was the research conducted by Georg Anschütz. Based on experimental psychology, Anschütz investigated color/sound combinations, organized four congresses between 1927 and 1936, and published three substantial volumes that took in areas far beyond the core subject of psychology.[54] The Second Color/Sound Congress in 1930 in Hamburg was attended by psychologists, scientists, and cultural studies scholars as well as artists—Ludwig Hirschfeld-Mack, Zdeněk Pešánek, and Baron Anatol Vietinghoff-Scheel. A "science and art exhibition" with a program featuring works by synesthesists, film screenings of works by Oskar Fischinger, and a planned demonstration of the apparatus constructed by Walter Brinkmann, attracted around 2,000 visitors. The aim of this considerable undertaking, however, remained curiously vague. As Georg Anschütz remarked in his introduction, color/sound research incorporates "the peripheral and the central, the sensory and the intellectual." To accomplish its purpose it needs to bring about a "vision" (which is not specified) from a "mystical and dark sphere and recognize that it is something intrinsic to all human beings, it permeates and rules our entire thinking, endeavors, and work."[55] Anschütz's call for "a new synthesis of mind" and "a new type of human" are reminiscent of the holistic quest for world harmonies; however, as they were supposed to arise from "the primordial and healthy mental force of our people" his career under National Socialism is hardly surprising.[56]

In the examples discussed above, a tendency can be found which objectifies aesthetics scientifically and operationalizes beauty technically through the synthesis of image and sound in electrical oscillations. In the 1960s there is a continuation of this in cybernetics and computer-generated creation or art analysis, for example, in the work of Max Bense. Theodor W. Adorno and Hanns Eisler had already criticized this tendency with reference to absolute film and color/sound music as "speculations that seek to develop laws from the abstract nature of the media as such, for instance from the relation between optical and phonetical data . . . If artistic beauty is derived exclusively from the material of the given art, it is degraded to the level of nature, but does not thereby acquire

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51 Fritz Wilhelm Winckel, *Technik und Aufgaben des Fernsehens* (Berlin: Rothgiesser & Diesing, 1930), 59; on Winckel see the detailed essay by Birgit Schneider in this volume.

52 Fritz Wilhelm Winckel, "Vergleichende Analyse der Ton- und Bildmodulation," in *Fernsehen* 1, 1930, 171–175.

53 Helmuth Plessner, *Die Einheit der Sinne: Grundlinien einer Ästhesiologie des Geistes* (Bonn: Cohen, 1923), 106.

54 Georg Anschütz, ed., *Farbe-Ton-Forschungen, Vol. 1,* (Leipzig: Akademische Verlagsgesellschaft, 1927); Anschütz, *Farbe-Ton-Forschungen, Vol. 3*; Georg Anschütz, ed., *Farbe-Ton-Forschungen, Vol. 2*, (Hamburg: Psychologisch-ästhetische Forschungsgesellschaft, 1936); cf. Jörg Jewanski, "Kunst und Synästhesie während der Farbe-Ton-Kongresse in Hamburg 1927–1936," *Jahrbuch der Deutschen Gesellschaft für Musikpsychologie* 18 (2006): 191–206.

55 Anschütz, *Farbe-Ton-Forschungen*, V, VI.

56 Georg Anschütz, "Die neue Synthese des Geistes," in idem *Farbe-Ton-Forschungen*, 315–316. From 1936 Anschütz was director of the office for the promotion of young teachers in the Nazi association of lecturers and from 1939 leader of the Nazi district association of lecturers (Gaudozentenbund).

natural beauty."[57] The question of where to draw the boundaries between nature and culture, which had accompanied this thematic complex ever since Castel and Chladni, finds its continuation in this context.

Perspective: Hybrid Artefacts in Socio-Technical Networks

In the Weimar Republic a multilayered network of media, art genres, and academic disciplines grew up around image/sound relations. There was extensive interaction between artistic and technical media: painting, music, and sound poetry met film, sound film, radio, and television. Furthermore, there were inventions, like Hausmann's Optophone and Brinkmann's apparatus. An interdisciplinary diversity of aesthetic and technical competence was involved here: painters became filmmakers and inventors of technical devices (Ruttmann), musicians and filmmakers became pioneers of the radio play (Weill, Ruttmann), artists worked with electrical engineers (Moholy-Nagy and Brinkmann, Hausmann and Broido), psychologists analyzed films (Anschütz and Fischinger), and engineers proposed art theories (Winckel). The scientific contexts included philosophy, anthropology, art and music theory, experimental psychology, physiology, acoustics, and electrical engineering. This description covers just one country (Germany) during one decade; it documents how concentrated and networked the situation was, and clearly it is not possible to break the situation down into the categories art, technology, science, and media industry without forfeiting its inherent dynamics and its significance. Yet even for this relatively well-documented chapter of German cultural and media history an adequate interdisciplinary account does not exist.

Bruno Latour coined the term socio-technical networks for such complex overlappings of scientific and scholarly disciplines, whereby he especially refers to the separation of culture and nature. According to Latour, it is within these networks that so-called hybrids emerge to defy modern scientific categorization, because the networks are not discernible from the given perspectives of the separate disciplines.[58] Especially in the area of audiovisuology we are confronted by such networks since the late nineteenth and early twentieth centuries. We no longer meet with singular artefacts as curiosities, like the color organs, or laboratory experiments like Chladni's sound figures, or the Phonoautograph, but instead we encounter a multiplicity of phenomena and artefacts that cross-reference each other and that originate from completely heterogeneous social, cultural, and scientific contexts.

Following the historical development outlined above, it becomes clear that the roots of hybridity reach back to the eighteenth century, and that audiovisual devices play a key role, because these artefacts function as hinges and establish links between different contexts. However, the problem is not historical; rather, it is a situation that remains unchanged today: its complexity is increasing over time with the proliferating technical possibilities, especially where electronics serve as the link between image and sound.[59] This has resulted in contemporary practice being more advanced than theory, as mentioned in a review of existing literature on the topic in the Preface. Building on a historical

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57 Theodor W. Adorno and Hanns Eisler, *Composing for the Films* (London: Continuum, [1947] 2005), 64–65.

58 According to Latour these socio-technical networks are "simultaneously real, like nature, narrated, like discourse, and collective, like society" and therefore represent an unresolvable contradiction for modern scientific thinking; Bruno Latour, *We Have Never Been Modern*, 6.

59 On the role played by electronics in the 1950s and 1960s see: Dieter Daniels, "From Visual Music to Intermedia Art," in: Rainer, Rollig, Daniels, and Ammer, *See This Sound: Promises in Sound and Vision*, 240–253.

basis, the goal of *Audiovisuology* is to somewhat reduce this gap between theory and contemporary practice.
Just how topical the cited historical characteristics of hybridity are for current practice is illustrated by this quotation from Golan Levin's contribution on software art from the first *Audiovisuology* volume:

> Such works are produced for diverse social contexts and can serve a variety of objectives. In the field at large, and in the examples discussed in this article, software artworks serve some of the same aims as do cinema, performances, installations, interior design, games, toys, instruments, screensavers, diagnostic tools, research demonstrations, and even aids for psychedelic hallucination—though many projects blur these boundaries to such an extent that categorization may not be very productive. Likewise, audiovisual software artworks continue to emerge from plural and only occasionally intersecting communities of research scientists, new media artists, software developers, musicians, and isolated individuals working outside the institutions of the laboratory, school, museum, or corporation.[60]

Again, let us call to mind the multiplicity of applications and contexts that Castel envisaged for his ocular harpsichord. Two and a half centuries later, the genuine hybridity of devices and artefacts at the interface between hearing and seeing reaches far wider circles and contexts. Yet their acceptance is by no means a foregone conclusion. A deliberate rejection of self-classification is still subject to strong pressure in art, science, and media technology. Latour describes the following paradox: "The modern Constitution allows the expanded proliferation of the hybrids whose existence, whose very possibility, it denies."[61]

The many hybrid devices, which emerge at the interface between the acoustic and the visual, are exemplary for this conflict in the modern era. On the one side they are part of the positivist history of progress and the ongoing process of differentiation in art, science, and technology in the narrative of the modern era. The propositions discussed above that aim to operationalize the arts as electrical oscillations, are symptoms of such a belief in technocratic feasibility. On the other side, the contexts of the creation of these artefacts frequently reveal a longing to recover a pre-modern wholeness. This also drives the success of image/sound synthesis in pop culture and the great interest in scientific research on synesthesia. The search for wholeness can turn back to holistic models of world harmony and lead to a theological, occult, spiritual, or drug-induced escape attempt from modernity.[62] As the essay by Chris Salter in this volume illustrates, however, recent theories of neuroplasticity posit a dynamic, sensorimotor concept of the interlacing of body, self, and environment, which has been demonstrated for the cross-modal circuitry of vision and hearing.[63]

Thus the thematic field's genuine hybridity also transcends the opposition of modern and anti-modern. The goal of *Audiovisuology* is not to establish a new scientific discipline, but to outline a model for dealing with this hybridity, to sustain it with open eyes and ears, and to withstand the temptation to construct fallacious syntheses.

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60 Golan Levin, "Audiovisual Software Art," in: Daniels and Naumann, *See This Sound: Audiovisuology Compendium*, 270–277, here 270.

61 Latour, *We Have Never Been Modern*, 34.

62 In the section "A Perverse Taste for the Margins," Latour describes how the moderns and antimoderns "frighten each other by agreeing on the essential point: we are absolutely different from the others, and we have broken radically with our own past." Latour, *We Have Never Been Modern*, 124.

63 This is not only found in persons who have lost a sense faculty through injury, but can also be demonstrated in non-impaired test persons; see the essay by Chris Salter in this volume.