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,

---

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.

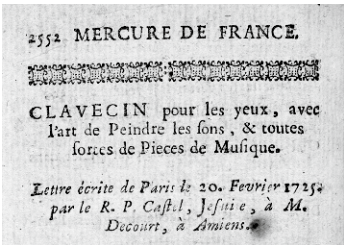
5 On the various usages of the concept of hybridity, see Schneider and Thomsen, *Hybridkultur*, 1997; Gerfried Stocker and Christine Schöpf, eds., *Hybrid: Living in Paradox. Ars Electronica 2005* (Ostfildern: Hatje Cantz, 2005).

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.

---

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

---

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

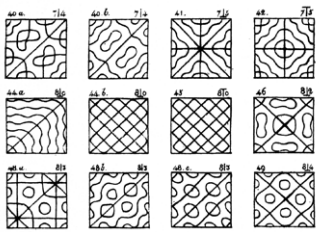
14 Cf. Maarten Franssen: "A picture emerges of a man gradually worn out completely by his own invention, although he kept believing in it to the last." Maarten Franssen, "The Ocular Harpsichord of Louis-Bertrand Castel: The Science and Aesthetics of an Eighteenth-century cause célèbre," in: *Tractrix. 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*.

---

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

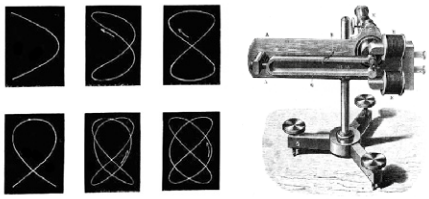
The hybridity of science, art, entertainment, and commerce outlined here can also be demonstrated specifically for the development of media technology. This not only concerns the heterogeneous motivations for and contexts of current inventions, but also the hybridization of the optical and acoustic processes,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

---

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]

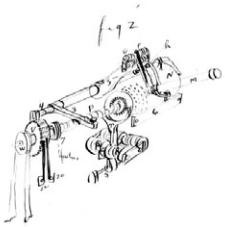
The history of ideas for the transmission medium television and the storage medium of film operate in the gap which had developed between image and sound as a result of photography, telephony, and the Phonograph: if still images and time-based sounds can be stored—and sounds can be transmitted electronically—why 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.

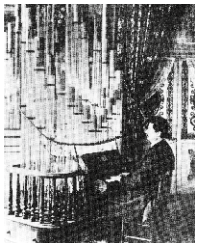
Helmholtz modified a telegraph constructed by his friend Werner Siemens and around 1860 the vibration microscope was created. The instrument visualizes

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),

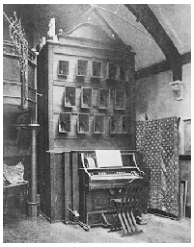
28 Thanks to Jan Thoben for his support in differentiating the argument on Helmholtz.

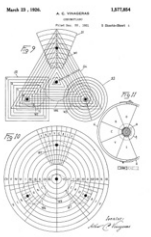
29 "Through this the qualitative differences in the visual impressions are attributed to the various receiving nerves. Then there remains only the quantitative differences of stronger or weaker excitation for the impressions of each optic nerve fiber. The same is accomplished by the hypothesis for hearing, 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.

---

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.

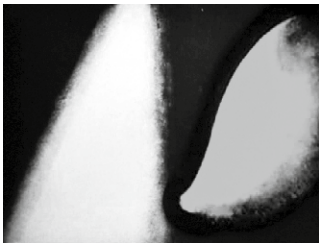
We are now approaching an issue of methodology, for which Bruno Latour coined the term "pragmatogony" to mean a mythical genealogy of the objects. Pragmatogony describes an indissoluble, iterative interaction of social processes and technological artefacts through which, according to Latour, the dualism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

---

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]

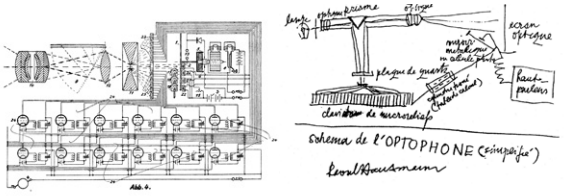
The indissolubility of this hybridity is also the main reason for what one could describe as being lost in interdisciplinarity. On one side, this concerns the cultural and scientific evaluation of individual phenomena (artworks, devices, theories), which, depending on their location within an art genre (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]

---

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.

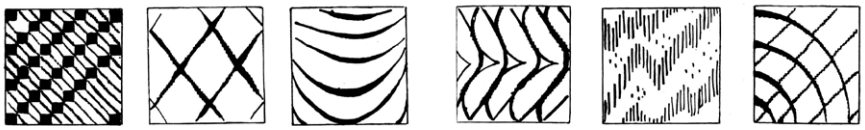
Case Study: Socio-Technological Networks. Absolute Film, Radiophonic Art, Electrical Engineering, Anthropology, and Synesthesia Research in the 1920s in Germany

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

---

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

---

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.

---

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.