

## Research on the history of modern acoustics

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Interview with Viktoria Tkaczyk, director of the Epistemes of Modern Acoustics research group at the Max Planck Institute for the History of Science, Berlin

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## **RESEARCH IN THE HISTORY OF MODERN ACOUSTICS**

**Interview with Viktoria Tkaczyk,  
Director of the *Epistemes of Modern  
Acoustics*, Max Planck Institute for  
the History of Science, Berlin**

**FRANÇOIS RIBAC**

### **ABSTRACT**

In this article, Viktoria Tkaczyk, who leads the research team *Epistemes of Modern Acoustics* at the Max Planck Institute in Berlin, discusses the ongoing works, the research perspectives and the “sound” turn within history of sciences. She introduces her working team members and their research objects, which encompass a range of several works dealing with the situation of sound and music within the sciences since the Scientific Revolution. As she highlights the importance of some actors who tend to be omitted, she points out how another conception and history of sciences arose. She also shows how sound can be used, like Mach did for example, as a tool of knowledge in order to investigate fieldworks that might not be related to sound at first sight, or to build up laboratories, to produce new objects and so on. She draws a condensed survey of works, very little known in France yet, that combine History of Sciences, Sound Studies and Music Knowledge. Music and sound are addressed from the perspective of the history sciences, including measures and standardization; and simultaneously, the history of sciences is sort of considered through a “re-sonification”.

**Keywords:** History of sciences, Sound studies, Science and Technology study, sonic turn, instruments

*Could you introduce yourself in a few words?*

I currently lead the five-year research group “Epistemes of Modern Acoustics” at the Max Planck Institute for the History of Science in Berlin, and I hold a professorship in the History of Knowledge, *L’histoire du savoir*, at the Humboldt-Universität zu Berlin. Maybe some biographical information: I obtained my PhD in theatre studies at the Freie Universität Berlin, with a dissertation on the history of stage technology in the early modern period. That drew me into the history of mechanics and experimentation, or the history of sciences more generally. So I began to combine themes, methods, and approaches from different disciplines: theatre studies, cultural studies, and the history of science and technology. I spent a year as a Feodor Lynen postdoctoral fellow at two CNRS laboratories in Paris (Atelier de Recherche sur l’intermédialité des Arts du spectacle, and Recherches Épistémologiques et Historiques sur les Sciences Exactes et les Institutions Scientifiques). And before returning to Berlin, I was an assistant professor of arts and new media at the University of Amsterdam.

*Could you explain the name of the research group “Epistemes of Modern Acoustics”?*

Our group is influenced by the methods of historical epistemology, and we start from the Foucauldian term “episteme,” understood as the enabling conditions of knowledge. We look at the different ways in which acoustic knowledge emerged throughout the modern period, or how acoustic knowledge was facilitated in certain cultural contexts. We are interested in the sociopolitical and religious circumstances, the technological infrastructures and artistic practices, but also the intellectual possibilities that made possible the study of acoustics.

*What does acoustics mean for you?*

We take “acoustics” as it was defined and redefined by our historical actors from the eighteenth century to the present. Looking back at the eighteenth and nineteenth centuries, it is interesting to see that the early textbooks and papers did not only address the physical nature of sound, but also questions of perception and physiology. Most of these writings, by Joseph Sauveur, Ernst Chladni, or the Weber brothers, testify to this threefold interest: the propagation and reflection of sound, and the reception of sound by more psychophysiological means. As for the twentieth century, we are interested in how acoustics as a discipline was divided into different subdisciplines such as bioacoustics, electroacoustics, room acoustics, aeroacoustics... There was (and still is) no discipline of acoustics as such, but rather a fragmented research field of acoustics – one that behaves like a “parasite”: it slips under the umbrella of other disciplines. Scholars in those disciplines pursue research on sound without necessarily naming it acoustics. An example would be phonetics or psychology, which actually generated crucial insights into acoustics.

Our research group encompasses two postdoctoral fellows, four associated predoctoral fellows and about two to three guest scholars at a time. Individual projects range from the emergence of particular acoustic concepts (such as “auditory memory” or “background noise”), to acoustic norms (such as “performance pitch” or “noise level”), to the invention of acoustic materials and technologies (such as sound photography or speech recognition systems), to the genealogy of acoustic subdisciplines as varied as electroacoustics, audiology, and bioacoustics. We consider sound in its dual function as a research object and an epistemic tool. So first, we are interested in the making of the discipline of acoustics throughout the modern period, and explore the historical conditions that allowed acoustic knowledge to be turned into scientific knowledge and then back into the practices of musicians, architects, engineers, or everyday listeners. And second, we look at sonic strategies of knowledge production in various different scientific and humanities disciplines. What historical knowledge could be acquired only through particular listening techniques? Why, how, and when were musical instruments, audio technologies, or new sound apparatuses deployed as alternative means of research?

*The word “modern” refers more to the nineteenth and twentieth century? So you don’t date modernity to the Scientific Revolution and start there?*

We don’t predefine what modernity is, or the period or region on which scholars should focus. Looking at the variety of projects in our group, you will see that depending on the individual theme, each scholar follows her or his own understanding of modernity. But we certainly don’t trace modernity back to Aristotle. I would say that the time mark lies in the eighteenth century, so it’s something starting from 1700 onwards. In 1701, the French mathematician Joseph Sauveur defined acoustics as a scientific discipline for the first time. When I applied for this project, Sauveur was my starting point, but I wouldn’t take this too strictly and rather follow Shmuel N. Eisenstadt’s notion of “multiple modernities,” or Fredric Jameson’s critical reading of the ideologies and myths that have shaped the terms “modernity” and “modernism.” I think that especially with the history of acoustics, it’s intriguing to ask whether one can define a beginning or an end of modernity, or whether that is even necessary.

*In Francis Bacon’s New Atlantis (Bacon, 1627) there is a short passage about the house of sounds, where he describes how sounds could be changed, echoed... But not many people talk about this passage.*

There is a wonderful book by Penelope Gouk (1999), *Music, Science and Natural Magic in Seventeenth-Century England*, that explores Bacon’s writings on sound in *New Atlantis* and *Sylva Sylvarum*. As with so many other phenomena,

Bacon paved the way for an academic but experimental approach to sound. The seventeenth century is a particularly interesting period for the study of acoustics because it unites so many different ideas about the nature of sound and so many methods of studying sound, whether theoretically, experimentally, or in practice. I lead another small sub-project, “Acoustic Dissonances” at the Freie Universität Berlin’s Collaborative Research Center “Epistemes in Motion,” which focuses on the formation of acoustics in the seventeenth century. One of my colleagues in this project, Leendert van der Miesen, is working on Marin Mersenne and René Descartes – situating their theoretical writings on sound within the material culture of seventeenth-century France and the Netherlands. He traces the influence of practices of musicking, instrument making, singing and composing, and acoustic warfare. Another colleague in the project, Anna Laqua, works on acoustic techniques of surveillance and espionage in England under Oliver Cromwell in the second half of the seventeenth century.

*Now I have a general question on the preeminence of vision. Many people think that sound, and in a certain way music, too, have been neglected in the humanities and in Science Studies. What would you say about that?*

In the early years of sound studies (Pinch & Bijsterveld, 2012), the traditional dominance of vision in Western culture was often given as a reason to change perspective and call for a “sonic turn” in the humanities. When I applied for this research group, which is already five years ago, there was still far less research on sound history, or more specifically on the history of acoustic knowledge formation. Back then, historians of science had published widely on the history of the telescope and other optical media, or on optical research methods such as photography or X-rays. Apart from the studies by Myles W. Jackson (Hui, Kursell & Jackson, 2013; Jackson, 2008), Emily Thompson (Thompson, 2002), and Olivier Darrigol (Darrigol, 2012), there was hardly any outstanding work on sound and the sciences. But the field changed quickly. Nowadays, so many excellent scholars are working on sound, and there is such innovative work on sound, that I feel almost sorry for art history and visual studies. The reasons for this are certainly manifold. Probably processes of digitization, and thus the easier availability of audio data and sound analysis tools, are key among them.

*In France, for a long time “acoustique” meant Emile Leipp (1984), and it was for musicians and others who worked on acoustics in a very scientific way. How do you explain the silence about sound before the change you have mentioned?*

It might have to do with shifts in user practices and general knowledge. Before the digital age, general knowledge about how photography or other

optical media worked was far more detailed and widespread than knowledge about the gramophone, tape recording, or audio processing – the latter still being associated mainly with musicians, sound engineers, and recording amateurs. In the digital age, the availability of affordable recording technology and audio software changed fields of expertise and interest. More people now have their sound studios at home, more academics work on sound or the history of sound. In academia, the delayed interest in sound might also have to do with publishing strategies. It is still easier to include images in a publication and to circulate visual data, while acoustic phenomena are harder to grasp and represent.

*When Jonathan Sterne's The Audible Past (Sterne, 2003) was published, many people discovered that the stethoscope was also used for gramophone and radio. So by investigating sound, we can understand a form of knowledge circulation and at the same time find a different way of looking at medicine, for example.*

Jonathan Sterne's *The Audible Past* is a brilliant study, speaking to scholars in Media studies, History of science, and Sound studies. And it probably came at just the right moment. In the humanities, one shift follows another – the iconic turn, the spatial turn, the performative turn... The time was ripe for a sonic turn and more attention to an “audible past” that is more broadly conceived than music history or the history of acoustics.

*This is a Kuhnian (Kuhn, 1983) explanation?*

I am not sure. Paradigms in the Kuhnian sense are far more complex and far-reaching than what we call “turns” in the humanities. Kuhn described paradigm shifts as fundamental changes in worldviews, but the “turns” in the humanities might rather be considered as changes in perspective or “academic fashions.” Paradigm shifts occur once or twice per century, new scholarly turns come and go in every decade.

*But what about outside the scientific field?*

I guess it's not about the inside or outside of academia. Rather, the various disciplines in the sciences and the humanities that deal with sound started to open up for fields of application. Think of the traditional discipline of musicology. From the late nineteenth century until the 1980s, musicology departments at universities strongly resembled literary studies, concerned with scores and philological interpretations – yet now the discipline is more and more open to questions of performance, cultural transfer, and music technology. Conversely, practitioners today seem far more willing to engage with music theory or sound studies.



*You presented a paper about Ernst Mach at the workshop Betwixt and Between<sup>1</sup>, and one of your main points was to show that sound was a tool of knowledge. That seems to be at the core of your own research?*

In my work on the physicist Ernst Mach, I trace how, in the late nineteenth century, sound changed from being an object of scientific research to being a research tool. Mach's research on shock waves is an useful example. He compared the speed of explosive matter or of projectiles to the speed of sound in the same medium (air). These experimental measurements led to what we call today the Mach number. In aviation, the Mach number represents the ratio of the speed of a flying object (flow velocity) to the local speed of sound in the same medium. So the Mach number is not an absolute quantity, but a dimensionless figure representing the ratio of two quantities – epistemically, the speed of sound becomes a relational feature. How did Mach arrive at this epistemic functionalization of sound? This paper is part of my larger project on the new epistemic functions of sound around 1900. I am interested in the discovery of the auditory cortex in the human brain in late nineteenth-century neuroanatomy and how it was taken up in disciplines from psychology, psychoanalysis, phonetics, and linguistics, to language pedagogy and musicology, but also in physics (by Mach and others).

*So do you see this as a turning point?*

Historians of science and technology have often described the late nineteenth century as a turning point, triggered by the invention of new auditory media (Friedrich Kittler), by new work on the psychophysiology of hearing – Alexandra Hui (2012) – or by a whole range of auditory cultural practices that were entangled with the invention of new media (Jonathan Sterne). I hope to provide yet another perspective on the time around 1900 by arguing that it was mainly research on auditory cognition that facilitated new concepts of “thinking with sound” in a wide range of disciplines and fields of art and communication.

*In Science and Technology Studies, there is a strong tradition of history of how people work in research labs. Do you follow that tradition?*

Research never starts in the laboratory. I and many of my colleagues do work on laboratory research and the history of experiments. But we take this as an end point rather than a starting point, aiming to show how such

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<sup>1</sup> Conférence Betwixt and Between: Sound in the Humanities and Sciences les 15 et 16 février 2018 au Max Planck Institute for the History of Science, Berlin. Organisée par Viktoria Tkaczyk, Hansjakob Ziemer et Julia Kursell. [https://www.mpiwg-berlin.mpg.de/sites/default/files/2018-02/Betwixt%26Between%20Workshop%20booklet%20A5\\_online.pdf](https://www.mpiwg-berlin.mpg.de/sites/default/files/2018-02/Betwixt%26Between%20Workshop%20booklet%20A5_online.pdf)



laboratories were set up, what political conditions enabled them to come into being. If we look at the laboratory research on sound in the nineteenth century, for example, we see that many of the instruments used there derived from musical-instrument making, and even the expertise of the physicians or physiologists stemmed from musical training. So we consider the laboratory as a place of transition, with an inside and an outside. In the 1980s and 1990s scholars in “laboratory studies” tended to approach the laboratory as a rather closed experimental setting or experimental system, in order to examine this system and its dynamics in every detail and over a longer period of time. Currently scholars are becoming more interested in the social conditions of the laboratory, in shifts from experiments to standardized tests, in political applications of scientific research, in the availability and sustainability of the materials used in laboratory research, and so on.

*In the history of sound reproduction, the industrial labs of Bell and Edison were very important. They did not work in exactly the same way as scientific labs (Reich, 1985). Does this mean something for acoustics?*

Some members of our research group are actually working on the Bell laboratories and on Edison. Visiting scholar Alexandra Hui, for example, has a wonderful project on the history of background music in Edison’s phonograph company. That is an early case of industrial laboratory research on music and the use of music for psychological manipulation.

*I would like to come back to the paper about Mach that you presented at the Betwixt and Between conference. You showed us that Mach used a very complex installation for his experiments. What I thought while I was listening was: Who built that installation; who were the workers, the engineers, how was it made? How about the network of people involved? Are you working on that?*

For Mach, we know that he had a rather well-equipped laboratory at the institute of physics in Prague, with instrument makers and several scientific assistants supporting his research. Most of Mach’s research on shock waves was teamwork – even to the extent that Mach’s authorship is questionable. In the collaboration between Mach and the physicist Peter Salcher, for example, their letters reveal that it was Salcher and not Mach who performed a long series of shock wave experiments, improved the methods of sound photography, and reached the most significant findings regarding what later became known as the “Mach number.” Mach’s and Salcher’s work was financed by the military, wartime industry, and private donors.

*When the Beatles were in the recording studio in the 1960s, the tape recorder was often left running. So the archives of the Beatles recordings give us not only all their songs, but also their discussions, improvisations, mistakes, experiments, alternative takes. It's incredible and very useful (Lewisohn, 1990). My question is how to do history of sound in science before the phonograph. How does it work? Do you see new methodologies?*

Whereas the Beatles had their tape recorder listening to them, earlier research in sound was documented in protocols, reports, visual sketches, laws, diaries, correspondences, etc. But sound recording certainly changed scholarly methods. The first scientific sound archives emerged in the 1890s, though they were few and many of them have since been destroyed, or the remaining recordings are difficult to access. And for the time before the 1870s, there is, excepting Léon Scott de Martinville's now reconstructed phonautograms<sup>2</sup>, no sound recording. But musicologists and media archaeologists have given us techniques to reconstruct the sounds of the past – be it study scores, the use of historical instruments, or reconstructions of historical concert halls. Colleagues in our research group also work with reconstructions of acoustic experiments.

*As Otto Sibum has done with Joule instruments (Sibum, 1995)?*

Roland Wittje (2016) is reconstructing acoustic experiments. As a guest of our research group, he reconstructed Theodor Simon's singing and speaking arc as used in Göttingen. With Paolo Brenni in Florence, Wittje recreated the exact laboratory setting for the singing frame in order to understand processes that you could not understand by mere description.<sup>3</sup> Only then did they realize Simon was using certain tools that he does not mention in his experiment and settings. Another interesting object of historical reconstruction is architectural acoustics. A colleague at the Technische Universität Berlin, Stefan Weinzierl, has used computer simulation to reconstruct Beethoven's concert halls, Renaissance theatres, and more recently the Agora in Athens. Such simulations are based on measurements in the preserved buildings or on architectural treatises and plans. You will probably never be able to reproduce the exact historical sound or know how the sound was perceived by historical actors, but the method of reconstruction raises new questions: What building material was used? Was every seat in the audience taken? Were the windows open or closed? For our research group, though, the traditional method of discourse analysis is still important. We are not only interested in how certain historical objects sounded, but also in the way that historical actors talked and

2 On the processing of Léon Scott de Martinville's phonautograms see [www.firstsounds.org](http://www.firstsounds.org)

3 <https://acoustics.mpiwg-berlin.mpg.de/node/658/>

thought about those sounds, or how hearing was studied and how certain technologies were invented: Who invented these technologies, who used them? What kind of manuals were produced, who reused them and produced them in other contexts? The spectrograph is one example of a technology that travelled through the history of twentieth-century bioacoustics but was also maintained and modified by other fields of research.

*So it relates to the materiality of things?*

The “materiality of things” is hugely relevant for the history of acoustics. Two years ago we had a project on sound archives in the sciences and humanities<sup>4</sup>, and our current project “Sound Objects in Flux” traces the global, long-term, and large-scale formation of particular objects such as bells, stringed instruments, vacuum tubes, concert halls, or inner voices. We ask how these objects’ very form and material was entangled with their cultural and sociopolitical setting, the knowledge of professional and lay users, and the expertise of scientists.

*Do you work on the dissemination of sound knowledge, like that of the telegraphers who learned by doing that it was easier to use sound than light to transcribe Morse code?*

This plays an important role in almost all our projects. Especially in Fanny Gribenski’s postdoctoral project on the history of concert pitch – a history that starts with intensive negotiations between musicians and scientists or scholars, but then becomes an issue of everyday life: standards define how you hear sound, how you perceive sound, how you sell sound, the detail of commercial trade and laws. Dissemination is also vital in Joeri Bruyninckx’s work on the history of bioacoustics (Bruyninckx, 2018), which shows how amateurs and semi-professionals shaped several scientific findings about bird vocalization. These hobby ornithologists picked up certain scientific approaches but then developed them, modified them, and, sometimes, reintroduced them to academia. Xiaochang Li’s project on the history of automatic speech recognition is another example, again very much in the applied sciences, with engineers taking up the role of linguists.

*You know Foucault’s interpretation that scientific knowledge is disseminated in society and frames people in many ways: subjectivation. What does that mean in terms of sound?*

It’s important to emphasize that acoustic research did not take place solely in the sciences. There is a broader scientific interest in sound encompassing the

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4 “Listening to the Archive: Sound Data in the Humanities and Sciences,” ed. Carolyn Birdsall and Viktoria Tkaczyk, special issue of *Technology and Culture* (forthcoming 2019).

social sciences, the natural sciences, and the humanities. But this also goes back to your question regarding what our research group is about. I would never give primacy to scientific research, because a *dispositif* does not start with scientific research alone but with a combination of cultural, religious, artistic, and political practices and particular political, social, architectural conditions – all of them together result in a scientific insight. We might look at a particular piece of knowledge that gains prominence, for example the “Mach number” is defined and then regulates and standardizes aviation, but of course that is always a very long process, which needs to be contextualized. So the answer to your question is that there never is a paradigm as such or a *dispositif* as such. We would probably no longer assume such sharp ruptures between different *dispositifs* because we think much more in terms of modes of transition, of transformation and reuse in particular contexts. Our working group “Sound Objects in Transition” tries to show exactly that: a certain instrument, for example, might have a history of a thousand years, and there is always something that precedes what we think of as having established a certain invention or even *dispositif*.

*That's a good end, thank you !*

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# **RÉSUMÉ: RECHERCHE EN HISTOIRE DE L'ACOUSTIQUE MODERNE. ENTRETIEN AVEC VIKTORIA TKACZYK, DIRECTRICE DE L'EPISTEMES OF MODERN ACOUSTICS, MAX PLANCK INSTITUTE FOR THE HISTORY OF SCIENCE, BERLIN**

Dans cet entretien, Viktoria Tkaczyk, directrice de l'équipe Epistemes of Modern Acoustics au Max Planck Institut à Berlin traite des travaux en cours, des perspectives de recherche et du tournant sonore dans l'histoire des sciences. Elle présente son groupe de travail et leurs objets de recherche, une série de travaux sur la place du son et de la musique dans les sciences depuis la Révolution Scientifique. Elle rend compte de la façon dont émerge une conception et une autre histoire des sciences en donnant à certains acteurs une place qu'ils/elles n'avaient pas et en montrant comment le son a été utilisé, par exemple par Mach, comme un outil de connaissance pour explorer des terrains non soniques, édifier des laboratoires, produire des objets, etc. Elle résume un panorama de travaux, peu connus en France qui croisent histoire des sciences, Sound Studies et savoirs de la musique. Musique et son sont abordés sous l'angle de l'histoire des sciences, des mesures et des standardisations ; en même temps, l'histoire des sciences est en quelque sorte « resonorisée »

Mots-clefs : histoire des sciences, études du son, Science and Technology study, tournant sonore, instruments

RESUMEN: INVESTIGACIÓN EN LA HISTORIA DE LA ACÚSTICA MODERNA. ENTREVISTA CON VIKTORIA TKACZYK, DIRECTORA DE *EPISTEMES OF MODERN ACOUSTICS*, INSTITUTO MAX PLANCK DE HISTORIA DE LA CIENCIA, BERLÍN

En esta entrevista, Viktoria Tkaczyk, directora del equipo de *Epistemes of Modern Acoustics* en el Instituto Max Planck de Berlín, analiza el trabajo actual, las perspectivas de investigación y el giro sonoro en la historia de la ciencia. Presenta a su grupo de trabajo y sus objetos de investigación, una serie de trabajos sobre la importancia del sonido y de la música en la ciencia desde la Revolución científica. Cuenta cómo emergen una concepción y una otra historia de la ciencia, dando a unos actores un papel que no tenían antes, y mostrando cómo se usó el sonido, por ejemplo, con Mach, como medio de conocimiento para explorar terrenos no sónicos, construir laboratorios, producir artefactos, etc. Resume un panorama de obras, poco conocidas en Francia que cruzan la historia de la ciencia, los estudios de sonido y el conocimiento de la música. La música y el sonido aparecen desde la perspectiva de la historia de la ciencia, la medición y la estandarización; al mismo tiempo, la historia de la ciencia está de alguna manera “sonorizada”.

Palabras clave: historia de las ciencias, estudios de sonido, CTS, giro sonoro, instrumentos