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Carolyn Birdsall, Viktoria Tkaczyk

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Sound Data in the Humanities and Sciences

CAROLYN BIRDSALL and VIKTORIA TKACZYK

For it will retain a perfect mechanical memory of many things which we may forget.

—**Thomas Edison**[1]

On 22 August 1940, the German astronomer Harald von Klüber used a gramophone to record a brief speech about universal time. In this wartime recording, von Klüber discussed the relativity of time and the need for a global time standard. Temporal convergence, he proclaimed, would facilitate punctual communication, travel, and transportation—three aspects crucial to Germany's conduct of World War II but also relevant for a range of different research disciplines that were concerned with temporal accuracy. As von Klüber referred to the newest technologies for measuring and synchronizing time with elaborate quartz clocks and wireless communication, he was also performing what he understood by standardized time, through the medium of sound recording: in order to reproduce his measured, persuasive voice, the gramophone disc needed to be played back at an exact, predefined rotation speed.[2]

1. Thomas A. Edison, "Perfected Phonograph," 649.
2. The recording is now held by the Saxon State and University Library in Dresden

When von Klüber made his recording, the technology of phonography had for some decades been regarded as offering a new means of preserving, measuring, and reproducing events in real time, particularly for the purposes of historical inquiry—as had photography and later film. A myriad of contemporary accounts affirms these technologies' promise to capture time. They are replete with references to the camera as historian and cinema as a new historical source, emphasizing the ability of photography and film to produce and archive indexical traces that could serve as evidence of past events.[3] In the case of the phonograph, inventor Thomas A. Edison had initially proposed a diverse set of applications, yet the mechanical recording and exact reproduction of sound, too, was soon framed more narrowly as a time capsule for future generations.[4]

The possibility of preserving sounds—and thus of subjecting such temporal phenomena to sustained scrutiny—meant that before long, phonographs (later gramophones) were being adapted to the needs of scientific research and related institutional agendas.[5] From around 1900, scientific sound archives in Europe were founded for the systematic collection, preservation, and study of phonographic recordings: the phonogram archives in Vienna, then Berlin, and the phonographic collections of universities in Paris, Leiden, Zurich, and St. Petersburg. Many of these projects staked encyclopedic and preservationist claims, mostly with the aim of collecting and researching all the world's languages, musics, and sounds.[6] At the same time, these archives regarded themselves as technological laboratories to develop and test new devices for the recording, storage, and reproduction of sound.

Starting from this early florescence of sound archiving initiatives, our Special Issue shows that the scientific sound archives were conceived according to temporal projections of past, present, and future. In some cases, sound data were intended for immediate reuse; in others, recordings were stockpiled for imagined future uses. Not uncommonly, sound holdings gave rise to research that was either futuristic or anachronistic—subject,

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and is accessible online as part of an archive of historical gramophone recordings: http://mediathek.slub-dresden.de/ton90000030.html.

3. H. D. Gower, L. Stanley Jast, and W. W. Topley, *Camera as Historian*; Boleslas Matuszewski, "New Source of History." See also Paula Amad, *Counter-Archive*; Mary Ann Doane, *Emergence of Cinematic Time*; Philip Rosen, "Document and Documentary."

4. See Edison, "Phonograph and Its Future."

5. Prominent examples are the recordings of Native American language, music, and rituals initiated by the Bureau of American Ethnology and carried out by the Smithsonian Institution. See Erika Brady, *Spiral Way*; also William Howland Kenney, *Recorded Music in American Life*, 73–74.

6. For comparable "total" and "world" archiving projects starting around 1900, see Markus Krajewski, *World Projects*; Boris Jardine and Christopher Kelty, eds., *Limn 6: The Total Archive*; Rebecca Lemov, "Filing the Total Human Experience"; Sven Spieker, *Big Archive*.

then, to the particular institution's own archival time.[7] Recording and play-back devices, too, were imagined as facilitating time-travel: they could help users to listen to recorded materials at exactly the same rotation speed (synchronized time), to accelerate or slow them down for detailed analysis (relative time), to preserve a constantly growing body of sonic heritage (linear-historical time), or to analyze and compare the archival holdings at any one moment (transcended time).[8] On the other hand, the creation and management of recorded sound collections was a costly, laborious, and, above all, time-consuming process. Not only did it take time to listen to recordings, but substantial processing time was required for the tasks of copying and editing, duplication and marking up, indexing and cataloguing. Another temporal consideration was the limited shelf life of recording media: from the outset, historical actors were aware of the fragility of wax cylinder carriers (later of magnetic tapes) and the damage caused by playback, as well as the difficulties of long-term preservation arising from physical degradation, generation loss, and, increasingly, format obsolescence.[9]

Picking up on the complexities of these time-related concerns, the authors in this Special Issue probe the histories of sound archives to ask whether and how early archives adapted the novel object of sound to existing academic infrastructures, archival practices, and governmentalities. How did such projects take shape? How did they prompt scholars to revisit research objects, methods, and standards? What was the significance of the material media involved in recording and preserving sound? And how do we keep our ears to the archival ground today?

"Listening to the Archive" investigates research-oriented sound data collecting in Europe and the United States as an important nexus of new technologies, archival practices, research methods, and scholarly disciplines. It examines multiple sites of such entanglements, ranging from the late nineteenth to the late twentieth century and on into the present day. Whereas historians of science and technology have worked intensively on the respective epistemic tasks of sound recording technologies and archival institutions, there is still surprisingly little historical scholarship on sound archiving within broadly defined cultural, technological, and scientific contexts.[10] "Listening to the Archive" aims to fill this gap, arguing that

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7. For the relationship of scientific archives to articulations of past, present, and future, see Lorraine Daston, "Introduction: Third Nature," 2–3.

8. This typology of time-based sound technologies follows and expands a schema suggested by Jonathan Sterne, *Audible Past*, 330. Sterne is referring to the programmatic text by Erich von Hornbostel, "Problems of Comparative Musicology," 252.

9. See the extensive list, spanning from the 1850s to the present, provided by the Museum of Obsolete Media (www.obsoletemedia.org/audio/).

10. For English-language publications that deal specifically with sound archiving and knowledge production, see the contributions to Anette Hoffman, ed., "Listening to Sound Archives." On the cultural framing of sound collections as "heritage," see Johannes Müske, "Constructing Sonic Heritage."

scholarly sound archives truly became "time machines" in multiple fields of knowledge processing as they produced, collected, stored, preserved, and reused sonic artifacts.[11]

The seven contributions trace, first, how systematic efforts to collect sound were framed in terms of epistemic regimes and authorities (such as national cultural prestige or colonial power). Of special interest here is the relationship between sound archival innovations and preexisting models of data collection, storage, ordering, indexing, and analysis. The articles demonstrate how sound archives—as research technologies—fostered the formation of a multitude of new research fields both within and between the sciences and the humanities, whether experimental phonetics (Feaster), tone psychology (Kursell), psychophysics and language pedagogy (Tkaczyk), radio studies (Birdsall), audio forensics and computational linguistics (Li and Mills), linguistic anthropology (Kaplan and Lemov), or bioacoustics (Bruyninckx). While each paper deals with specific sound archival cases, together they contribute to a broader understanding of the development, appropriation, and use of sound data in a great variety of disciplines.

The Special Issue looks, second, at the material form of historical sound data collections, their technical creation, and the skills and knowledge that each encapsulated. During the long twentieth century, sound data underwent fundamental changes with regard to technological processes of production, storing, transfer, and transmission—shifting from mechanical to electrical, from analogue to digital, from high fidelity to audio compression, from concrete sounds to synthetic sounds. The archival projects discussed here responded to these changes in different ways: some archiving initiatives prompted technological adaptation, innovation, and even entrepreneurship; others ignored technological novelty and remained wedded to the reuse of older technologies. This serves as an important corrective to the frequent assumption that scholars were ordinary users of existing consumer technologies.

The Archive as a Technology

A striking feature of scholarly engagements with archiving is the divergence in terminology to describe projects that were variously called a private collection, state repository, library, museum, or department. Despite this variety, we believe that the notion of "archive" offers a productive analytical lens. In particular, our investigation of sound archives builds on recent work that speaks of the archive as a *technology*. Initially inspired by the Foucauldian use of the term *archive* to refer to culturally and historically specific systems of regulating and distributing knowledge, historians

11. On the temporal dimension of sonic media, see Wolfgang Ernst, *Sonic Time Machines*.

of technology, science, and culture have since applied the same approach to actual archives—their specific materiality, mediality, and technicity—and shown how these function as complex sites for processing knowledge, science, and historical narratives.[12] If archival collecting was long associated with neutrality and inclusion, scholars are now interrogating the politics of archives and of archivist practices of acquisition, classification, preservation, and access provision.[13] Their critique has emphasized structural absences and exclusions, the archive's role as a technology of empire and knowledge distribution, and the challenges of reinterpretation in present-day post-totalitarian and postcolonial contexts.[14] Yet most such work focuses on archives comprising texts, images, or films—guided by the widespread assumption that the sciences have relied primarily on visuality, that is, on the textual and pictorial production of scientific knowledge and epistemic cultures.[15] This Special Issue, in contrast, addresses the epistemic potentials and technological challenges of *sound* archiving, from a multi-disciplinary perspective.

Our study of the archive as a technology begins with a contribution that reexamines the oldest analogue sound recordings available today. These are the phonautograms invented by Parisian typographer Édouard-Léon Scott de Martinville, who imagined this graphic mode of visualizing sound vibration as serving scientific interests and proposed using it to standardize concert pitch and language (Feaster). As the intentionally scattered presence of Scott's 1850s visual records of sound across a number of Parisian archives and libraries reveals, the paper-based traces were incorporated into existing institutional classification schemes, where they helped Scott to document his priority of invention. Yet, paradoxically, these print-oriented library and archival systems also *concealed* the technology of analogue sound recording, thus truncating contemporary and subsequent understanding of its significance.

Questions of archival exclusion become equally apparent in the case of the Phonogramm-Archiv in Berlin, founded by German psychologist Carl

12. Elizabeth Yale, "Introduction: Consider the Archive"; Lorraine Daston, "Sciences of the Archive"; Daston, ed., *Science in the Archives*; Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out*; Bruno J. Strasser, "Data-driven Sciences"; Marcus Friedrich, *Geburt des Archivs*.

13. Jacques Derrida, *Archive Fever*; Thomas Weitin and Burkhardt Wolf, eds., *Gewalt der Archive*; Anja Horstmann and Vanina Kopp, eds., *Archiv—Macht—Wissen*; Wolfgang Ernst, *Rumoren der Archive*; Eric Ketelaar, "Tacit Narratives."

14. Ann Laura Stoler, "Colonial Archives." See also Paul Basu and Ferdinand De Jong, "Utopian Archives"; on imperialism, archiving, and listening practices, Britta Lange, "*Poste restante*"; Ana María Ochoa Gautier, *Aurality*.

15. See Karin Knorr Cetina, "Epistemic Cultures"; M. Norton Wise, "Making Visible." A recent exploration of the relationship between photography/film, documentary evidence, and scientific practice is Gregg Mitman and Kelley Wilder, eds., *Documenting the World*.

Stumpf in 1904. This archive contained a series of recordings of whispered vowels for research on cognitive predispositions in listeners, produced by Stumpf during and after World War I. A near-silent recording among these holdings may be interpreted from today's perspective as an "anarchivic object"—a material object that escaped the archival practices and technologies of its day to encourage a reevaluation of the technology at hand and of archival formats such as filing cards, protocols, catalogues, finding aids, and databases (Kursell).

Remaining in early twentieth-century Berlin, the Lautabteilung ("sound department") of the Prussian State Library, led by language teacher and phonetician Wilhelm Doegen in the 1920s, again illustrates how tightly archival projects were bound up with power relations. Doegen's Lautabteilung served several state authorities in interwar Germany and attempted to unite the activities of an acoustic laboratory and an archive while also taking advantage of an emergent market for audiobooks. The collection comprised materials relevant to the interests of multiple disciplines ranging from linguistics and speech studies to musicology, ethnology, anthropology, zoology, criminology, medicine, and psychology. That marked an important shift away from earlier visions of scientific sound archives around 1900—driven by a historicist desire for exhaustiveness and conceived as being collected for the purposes of analysis—toward an understanding of sound archiving itself as a technology of applied research (Tkaczyk). The Lautabteilung in Berlin also proved an important early model for the engagement with radio as an object of academic study, particularly in combination with research-based sound recording and archival praxis. As such, the Lautabteilung served as inspiration for what would become Germany's first university radio studies department, founded in 1939 and premised on an archival logic of radio for teaching and research, some of which was conducted as part of wartime commissions for the Nazi regime (Birdsall).

With regard to archival infrastructures, the multiple histories of voice recording collections for the purpose of speaker identification, from the early twentieth century to the 1970s, present a compelling case of a shift from the sound archive (as the first means to archive and compare language in real time) to the acoustic database (as a site for large-scale comparisons of language recordings). The dynamics within the archive reveal that despite using new technologies of voice recordings, scholars also adopted traditional techniques of visual representation, assembling images of human voices with graphic inscription tools such as the phonautograph and logograph. Such techniques draw further analytical attention to the production of sonic data in reciprocity with other registers of archive media and scientific representation (Li and Mills).

A comparable attempt to apply established archiving processes (storage, cataloguing, and indexing) to precisely those elusive parts of human auditory experience that resist the efforts of scientific standardization

becomes apparent in the creation of large-scale sound collections in U.S. anthropology, whose strong "salvage" framework motivated a focus on the threatened languages of Native Americans (Kaplan and Lemov). The Archives of the Languages of the World, initiated by Carl Voegelin in 1954, reveal the significance and problematics of sound collections for anthropological and linguistic research in the first half of the twentieth century. This case demonstrates a centripetal movement of sound recordings into the archive, but also a centrifugal "data journey" as sound materials traveled back outward in ever new technological formats, eliciting both opposition and revitalization efforts in the process. The location of archives within larger networks of social actors and institutions also emerges from the case of the first systematically archived recordings of wildlife animal sounds in the fledgling field of bioacoustics in Britain (Bruyninckx). In constructing and expanding the resulting sound collections, the would-be archivists faced the difficult task of bringing together a wide-ranging network of instrument manufacturers, amateur sound hunters, scientists, and commercial users. The library anchored this archival community, whose stakeholders had a shared interest in the creation, use, and dissemination of the recordings. The archival record shows traces of transnational knowledge exchange and flows of materials, as well as multiple agendas and their effects on the collection and its associated archival processes.

Sound Technologies for and of the Archive

By making it possible to capture sonic events in real time, sound recording technologies permitted archivists to preserve and reinterpret speech, languages, music, or sonic architectures and environments. Soon after the invention of the phonograph, scholars enthusiastically began to replay, slow down, accelerate, or reverse the linear stream of temporal data in search of insights into its temporal and spatial structures. It was with this aim in mind that archival devices for time synchronization, compression, and acceleration were designed and developed.[16] Tracing these processes, our Special Issue builds upon a well-documented "sonic turn" in scholarship on technology and culture.[17] Scholars in STS have also worked extensively on the ways in which certain user groups consume, modify, domesticate, reconfigure, or resist technologies at a given moment in time.[18] That diversity of uses also marks the archives discussed here; the forms and functions of archival devices analyzed by our contributors often differed from the phonographs, gramophones, tape recorders, and digital

16. See Friedrich Kittler, "Real Time Analysis," 8.
17. Michele Hilmes, "Is There a Field Called Sound Culture Studies?"; Sterne, *Audible Past*. See also Owen Marshall, "Synesthetizing Sound Studies"; Steven Feld and Donald Brenneis, "Doing Anthropology in Sound"; Thomas Porcello, "Afterword," 270.
18. Nelly Oudshoorn and Trevor Pinch, eds., *How Users Matter*.

recording tools that were commercially available at the time.[19] We argue that these uses of technology require a careful consideration of their respective epistemic cultures. Drawing on historiographic methodologies and the sociology of knowledge, the essays thus investigate the embeddedness of technologies-in-use in the specific academic fields from which each archive emerged. Studying the development of "sonic skills" for documenting, preserving, and redistributing sound in microhistorical case studies, the Special Issue asks how technology is adapted to the very particular demands of individual researchers, single disciplines, or small-scale research communities over a certain period.[20] At the same time, it shows how long-standing scientific practices could merge with the application of novel sound recording and archival facilities.

The physical qualities of sound archives—the complex relationship between the ephemerality of sound and the durability of the archivable object—take pride of place in contributions that together span the period from the very earliest sound recordings, made in Paris in the 1850s, to the emergence of modern speech-recognition technology (Feaster; Li and Mills). Scott's nineteenth-century phonautograms might, in their material constitution as paper documents, be read either as the earliest analogue sound recordings or as paper documents of specific technical arrangements, use scenarios, and correspondences between sound and trace. Comparably, the failure of early speaker identification projects in the United States led to collections of sound spectrograms being redeployed to automate speech recognition. Machine speech recording—whether in phonographic, visual, or numerical formats—emerged as a leading scientific and bureaucratic application of sound recording with devices such as the Phonoscribe. The case of the "Audrey" Automatic Digit Recognizer documents another shift during the 1970s, toward statistical models derived from speech and text corpora. This statistical approach became the foundation for today's commercial speech recognition software and anticipated the rise of data-driven, or "big data," practices in speech recognition across a variety of natural language processing applications.

Alongside these more general trends, German psychologist Carl Stumpf's attempts to record the unrecordable shed new light on the local uses of technologies and their affordances, as Stumpf and his fellow researchers explored the functions and possibilities of their archival tools (Kursell). The frequency-level limits in an early twentieth-century recording apparently of whispered vowels mean that the wax cylinder seems to

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19. See Steve J. Wurtzler, *Electric Sounds*; Timothy Taylor, *Strange Sounds*; Heike Weber, *Versprechen mobiler Freiheit*; David Morton, *Off the Record*.

20. On "sonic skills," see Trevor Pinch and Karin Bijsterveld, "New Keys," 11–12; Andi Schoon and Axel Volmar, eds., *Das geschulte Ohr*; Tom Rice, "Sounding Bodies"; Stefan Helmreich, *Sounding the Limits of Life*; Joeri Bruyninckx and Alexandra Supper, eds., "Sonic Skills."

hold nothing more than background noise. Faced with such limitations of recording technology, archivists either reappropriated the intended uses of existing technologies or invented new ones, as in Wilhelm Doegen's improvements to the "glyphic" gramophone recording technique for recording the spoken word, his "sound-holder" to repeat short extracts, and his archive oscilloscope for the graphic representation and analysis of recordings (Tkaczyk; Birdsall). Alongside such theoretical endeavors, another driving force in early sound archiving initiatives was the commercial potential of scholarly recording technologies and collections. Many early archival entrepreneurs recognized sound recordings as a highly lucrative resource, though tapping into the new popular and commercial appeal of, for instance, birdsong recordings in postwar Britain did not prove an easy task (Bruyninckx). For sound libraries such as the British Library of Wildlife Sounds, commercialization required negotiations across divergent regimes of data production, access, recording aesthetics, technological standards, and information exchange.

Sonic Heritage in Use

Taken all together, the essays in this Special Issue may be considered a contribution to the history of a more general "boom" of archives and inter-archival dynamics in the modern period. From the late nineteenth century, archives began to prompt new modes of research and exchange in academic institutions. The issue's seven contributions present a rich and diverse corpus of sonic artifacts that offer lively sensory encounters with traces of the past. Considered as "time machines," sound archives at the turn of the twentieth century took sonic ephemera and tried to pin them down in time. Simultaneously, the sound archives discussed here started to look toward the future, becoming laboratories for new archival practices and standards, sites for the use of sound as an epistemic tool, and formative forces within both established and newly emerging disciplines. Like other scholarly data collection, sound archives were used as sites for capturing facts while also producing academic fiction.

Studying the formation and circulations of sound data in various different fields of research, the Special Issue pays attention to the ethics of data collection and interpretation. All the projects we address indicate the capacity of sound archives—perhaps more so than other forms of archiving—to nurture crossover between scientific endeavor and public interest. This formation of "sonic heritage," as a negotiated and contested terrain, brings into relief some urgent questions around the sensitivity of data collection, interpretation, and digital accessibility.[21] Some of the material examined here was produced in European archives shortly before or dur-

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21. See Margit Berner, Anette Hoffmann, and Britta Lange, *Sensible Sammlungen*.

ing World War II, and was intended to contribute to national identity formation (Tkaczyk) or wartime monitoring and surveillance (Birdsall). Other material facilitated the establishment of audio forensics as a scientific discipline and paved the way for today's systems of sonic surveillance, whose implications call for a sensitive revisiting of the history of these systems' technology (Li and Mills). Americanist anthropologists' archives of "endangered languages" indicate the nature of sound data as an ephemeral form that is especially difficult to classify and standardize, and indeed whose technological formatting and preservation may constitute forms of violence (Kaplan and Lemov). The "archive" of sound recordings, transcribed text, photos, artifacts, and bodily remains associated with the Yahi speaker Ishi (1861–1917) reveals the multiple imperatives and technological conditions that shaped the anthropological recordings in sound archives and their "second-order endangerment."

Our aim here is to take a first step in research on the epistemic challenges that sound archiving has posed within and between the humanities, the social sciences, and the natural sciences since the late nineteenth century—and even more so since the availability of digital sound archives and tools for sound analysis. In doing so, the Special Issue posits and demonstrates the benefits of carrying out carefully contextualized microhistories of the configuration and reconfiguration of particular sound technologies under distinct historical conditions, specifying their social-spatial relations with actors, objects, sites, and settings. We believe that more historical work remains to be done on the multilayered relationship between sound data, archives, and the formation of disciplines and scholarly networks—not to mention its relevance for a well-informed provenance research on sound archival objects.

Additional archival materials relating to this article can be accessed at the database "Sound & Science: Digital Histories," https://acoustics.mpiwg-berlin.mpg.de/sets/clusters/listening-archive/.

Bibliography

Amad, Paula. *Counter-Archive: Film, the Everyday, and Albert Kahn's Archives de la Planète*. New York: Columbia University Press, 2010.

Basu, Paul, and Ferdinand De Jong. "Utopian Archives, Decolonial Affordances: Introduction to Special Issue." *Social Anthropology* 24, no. 1 (2016): 5–19.

Berner, Margit, Anette Hoffmann, and Britta Lange. *Sensible Sammlungen: Aus dem anthropologischen Depot*. Hamburg: Philo Fine Arts, 2011.

Bowker, Geoffrey C., and Susan Leigh Star. *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press, 2000.

Brady, Erika. *A Spiral Way: How the Phonograph Changed Ethnography*. Jackson: University Press of Mississippi, 1999.

Bruyninckx, Joeri, and Alexandra Supper, eds. "Sonic Skills in Cultural Contexts: Theories, Practices and Materialities of Listening." Special issue, *Sound Studies* 2, no. 1 (2016).

Daston, Lorraine. "Introduction: Third Nature." In *Science in the Archives: Pasts, Presents, Futures*, edited by Lorraine Daston, 1–14. Chicago: University of Chicago Press, 2017.

———, ed. *Science in the Archives: Pasts, Presents, Futures*. Chicago: University of Chicago Press, 2017.

———. "The Sciences of the Archive." *Osiris* 27, no. 1 (2012): 156–87.

Derrida, Jacques. *Archive Fever: A Freudian Impression*. Translated by Eric Prenowitz. Chicago: University of Chicago Press, 1995.

Doane, Mary Ann. *The Emergence of Cinematic Time: Modernity, Contingency, the Archive*. Cambridge, MA: Harvard University Press, 2002.

Edison, Thomas A. "The Perfected Phonograph." *The North American Review* 146, no. 379 (1888): 641–50.

———. "The Phonograph and Its Future." *The North American Review* 126, no. 262 (1878): 527–36.

Ernst, Wolfgang. *Das Rumoren der Archive: Ordnung aus Unordnung*. Berlin: Merve, 2002.

———. *Sonic Time Machines: Explicit Sound, Sirenic Voices, and Implicit Sonicity*. Amsterdam: Amsterdam University Press, 2016.

Feld, Steven, and Donald Brenneis. "Doing Anthropology in Sound." *American Ethnologist* 31, no. 4 (2004): 461–74.

Friedrich, Marcus. *Die Geburt des Archivs: Eine Wissensgeschichte*. Munich: Oldenbourg, 2013.

Gower, H. D., L. Stanley Jast, and W. W. Topley. *The Camera as Historian*. New York: F. A. Stokes, 1916.

Helmreich, Stefan. *Sounding the Limits of Life: Essays in the Anthropology of Biology and Beyond*. Princeton, NJ: Princeton University Press, 2016.

Hilmes, Michele. "Is There a Field Called Sound Culture Studies? And Does It Matter?" *American Quarterly* 57, no. 1 (2005): 249–59.

Hoffmann, Anette, ed. "Listening to Sound Archives." Special segment of *Social Dynamics* 41, no. 1 (2015).

Hornbostel, Erich von. "The Problems of Comparative Musicology" (1905). Translated by Richard Campbell. In *Hornbostel Opera Omnia I*, edited by Klaus Wachsmann, Dieter Christensen, and Hans-Peter Reinecke, 249–70. The Hague: Martinus Nijhoff, 1975.

Horstmann, Anja, and Vanina Kopp, eds. *Archiv – Macht – Wissen: Organisation und Konstruktion von Wissen und Wirklichkeiten in Archiven*. Frankfurt am Main: Campus, 2010.

Jardine, Boris, and Christopher Kelty, eds. *Limn 6: The Total Archive* (March 2016), http://limn.it/preface-the-total-archive.

Kenney, William Howland. *Recorded Music in American Life: The Phonograph and Popular Memory, 1890–1945*. New York: Oxford University Press, 1999.

Ketelaar, Eric. "Tacit Narratives: The Meaning of Archives." *Archival Science* 2, no. 1 (2001): 131–41.

Kittler, Friedrich. "Real Time Analysis, Time Axis Manipulation." Translated by Geoffrey Winthrop Young. *Cultural Politics* 13, no. 1 (2017): 1–18.

Knorr Cetina, Karin. "Epistemic Cultures: Forms of Reason in Science." *History of Political Economy* 23, no. 1 (1991): 105–22.

Krajewski, Markus. *World Projects: Global Information Before World War I*. Translated by Charles Marcrum. Minneapolis: University of Minnesota Press, 2014.

Lange, Britta. "*Poste restante*, and Messages in Bottles: Sound Recordings of Indian Prisoners in the First World War." *Social Dynamics* 41, no. 1 (2015): 84–100.

Lemov, Rebecca. "Filing the Total Human Experience: Anthropological Archives at Mid-Twentieth Century." In *Social Knowledge in the Making*, edited by Charles Camic, Neil Gross, and Michelle Lamont, 119–50. Chicago: University of Chicago Press, 2011.

Marshall, Owen. "Synesthetizing Sound Studies and the Sociology of Technology." *Sociology Compass* 8, no. 7 (2014): 948–58.

Matuszewski, Boleslas. "A New Source of History" (1898). Translated by Laura U. Marks and Diane Koszarki. *Film History* 7, no. 3 (1997): 322–24.

Mitman, Gregg, and Kelley Wilder, eds. *Documenting the World: Film, Photography, and the Scientific Record*. Chicago: University of Chicago Press, 2016.

Morton, David. *Off the Record: The Technology and Culture of Sound Recording in America*. New Brunswick, NJ: Rutgers University Press, 2000.

Müske, Johannes. "Constructing Sonic Heritage: The Accumulation of Knowledge in the Context of Sound Archives." *Journal of Ethnology and Folkloristics* 4, no. 1 (2010): 37–47.

Ochoa Gautier, Ana María. *Aurality: Listening and Knowledge in Nineteenth-Century Colombia*. Durham, NC: Duke University Press, 2014.

Oudshoorn, Nelly, and Trevor Pinch, eds. *How Users Matter: The Co-construction of Users and Technology*. Cambridge, MA: MIT Press, 2005.

Pinch, Trevor, and Karin Bijsterveld. "New Keys to the World of Sound." In *The Oxford Handbook of Sound Studies*, edited by Trevor Pinch and Karin Bijsterveld, 3–35. Oxford: Oxford University Press, 2012.

Porcello, Thomas, "Afterword." In *Wired for Sound: Engineering and Technologies in Sonic Cultures*, edited by Paul D. Greene and Thomas Porcello, 269–79. Middletown, CT: Wesleyan University Press, 2005.

Rice, Tom. "Sounding Bodies: Medical Students and the Acquisition of Stethoscopic Perspectives." In *The Oxford Handbook of Sound Studies*, edited by Trevor Pinch and Karin Bijsterveld, 298–319. Oxford: Oxford University Press, 2012.

Rosen, Philip. "Document and Documentary: On the Persistence of Historical Concepts." In *Theorizing Documentary*, edited by Michael Renov, 58–89. New York: Routledge, 2012.

Schoon, Andi, and Axel Volmar, eds. *Das geschulte Ohr: Eine Kulturgeschichte der Sonifikation*. Bielefeld: transcript Verlag, 2014.

Spieker, Sven. *The Big Archive: Art from Bureaucracy*. Cambridge, MA: MIT Press, 2008.

Sterne, Jonathan. *The Audible Past: Cultural Origins of Sound Reproduction*. Durham, NC: Duke University Press, 2003.

Stoler, Ann Laura. "Colonial Archives and the Arts of Governance." *Archival Science* 2, no. 1–2 (2002): 87–109.

Strasser, Bruno J. "Data-driven Sciences: From Wonder Cabinets to Electronic Databases." *Studies in History and Philosophy of Science. Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 43, no. 1 (2011): 85–87.

Taylor, Timothy. *Strange Sounds: Music, Technology and Culture*. London: Routledge, 2014.

Weber, Heike. *Das Versprechen mobiler Freiheit: Zur Kultur- und Technikgeschichte von Kofferradio, Walkman und Handy*. Bielefeld: transcript Verlag, 2015.

Weitin, Thomas, and Burkhardt Wolf, eds. *Gewalt der Archive: Studien zur Kulturgeschichte der Wissensspeicherung*. Konstanz: Konstanz University Press, 2012.

Wise, M. Norton. "Making Visible." *Isis* 97, no. 1 (2006): 75–82.

Wurtzler, Steve J. *Electric Sounds: Technological Change and the Rise of Corporate Mass Media*. New York: Columbia University Press, 2007.

Yale, Elizabeth. "Introduction: Consider the Archive." *Isis* 107, no. 1 (2016): 74–76.