keywords in sound

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DUKE UNIVERSITY PRESS Durham and London 2015

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[4] Mara Mills

deafness

A *deaf spectrum*—or "deafnesses"—has replaced the deaf/hearing binary in both the biomedical and cultural realms. At the same time, audiometric categories of hearing impairment do not map neatly onto deaf identities. Depending on technology use and community affiliation, individuals with audiograms that register similar types of impairment might identify quite differently as Deaf (a cultural group defined by sign language use), deaf, late-deafened, deaf-blind, hearing, or hard of hearing. *Deafness* may be used colloquially to designate any kind of hearing difference; however, members of Deaf culture often reject the term as itself pathologizing.

In addition, Deaf scholars have reconceived *hearing loss* as *deaf gain* to account for the new representations, communities, and forms of cognition afforded by bodily and communicative difference (Bauman and Murray 2009). These gains range from the neurodiversity that accompanies visual-gestural languages to aesthetic and technical innovations. With regard to technology, gains often occur because inaccessible media systems necessitate adaptations; examples include closed captioning (sound-to-text translation) and telephone relay services. Deaf communities also produce their own "minor" media. Deaf Space, for instance, refers to architecture designed specifically for inhabitants who sign and, to a lesser extent, use personal amplification devices.[1] For scientists and engineers, deafness has yielded insights into the elements of speech and hearing, as well as possibilities for their reconfiguration: new techniques for sound synthesis and visualization, for instance, or new modes of listening.

Definitions of deafness have varied across time and national context, the net trend being the expansion of the category and the diversification of allied identities. Deafness did not become an object of scientific investigation and pedagogical intervention in Europe until the early modern period. Before the 1500s, congenitally deaf individuals and families were highly isolated. In the absence of amplification devices and precise

audiometric measurements, "deaf-mute" or "deaf and dumb" referred to those who—from an early age—could not hear the frequency range of the human voice.[2] It was widely believed that rational thought was dependent on speech. Prelingual deafness seemed inextricably linked to muteness; in turn, deaf people seemed incapable of intelligence and moral reason.

Early efforts at deaf education, motivated by the goal of religious instruction, yielded numerous visual and gestural modes of communication, including new methods for transcribing and analyzing speech. In 1620, the Spanish priest Juan Pablo Bonet published *Reduction de las letras y arte para enseñar a hablar los mudos*, the first treatise on deaf education, which discussed print reading, lip-reading, and the manual alphabet. Bonet advised "the reduction of letters" through the use of a phonetic alphabet as an aid for deaf students learning speak. Of Bonet, and the heirs to his system, Jonathan Reé comments, "the first inquirers to attempt an absolute notation for speech, tied down to invariant standards of sound, were the early oral educators of the deaf" (Rée 1999: 249).

The growth of the natural sciences and the general expansion of education encouraged further study of deafness in the 1600s. Anatomists had already begun to examine the outer and middle ear by the sixteenth century, but new instrumentation—microscopes and tiny surgical instruments—allowed the dissection of the cochlea and the auditory nerve beginning in the seventeenth. The mapping of anatomical structure provoked finer-grained theories of hearing and its impairment: loud sounds might damage the tympanum, for instance, or the bones might fuse in the middle ear. It had long been understood that human hearing was limited and declined with age, but now the boundaries of hearing capacity began to be charted. Using tuned organ pipes, physicist Joseph Sauveur offered an early estimate of the upper and lower thresholds of hearing around 1700.

Up to the sixteenth century, many anatomists believed hearing impairment to be untreatable, despite the prevalence of folk remedies. By the end of the 1500s, however, clinical examination became more elaborate, and the recesses of the ear began to be examined with a speculum. Artificial tympana and surgical treatments were proposed for middle-ear deafness. According to Georg von Békésy and Walter Rosenblith, "the new and more mechanical way of looking at the human body and the high development of mechanical art in the 16th and 17th centuries was responsible for the manufacture and use of prosthetic devices to replace parts of the body that had been injured" (1948: 745). Shells and animal horns had been used for

amplification since ancient times; however, designs for ear trumpets and bone conduction devices began to proliferate alongside theories of acoustics and hearing.[3] Amplifying trumpets were imagined to have manifold uses; tin dealers and trumpeters offered their devices for the hard of hearing, for overhearing, and for loud-speaking. Still, the term deafness was applied to "a wide variety of experiences including hearing impairments such as tinnitus and age related hearing degeneration" (Cockayne 493).

With deafness seeming like a difference in degree rather than a difference in kind, philosophers began to see in it the answer to many puzzles of communication: the nature of speech (its physiology and its instinctiveness), the interchangeability of the senses, and the comparability of sign systems. Another preoccupation of the seventeenth century was the possibility of a "universal language"—for international communication (spurred by the growth of vernacular publications and global trade); for language rationalization; or for insight into the origins of speech. As a route to philosophical experiment with simplified alphabets and artificial languages, scholars from diverse fields were motivated to teach prelingually deaf children.

Tutoring and small schools for deaf pupils spread throughout Europe in the second half of the seventeenth century, along with new pedagogical strategies and technical aids. Lines began to be drawn between the "oral" and "manual" approaches to deaf communication, represented most famously—and in nationalist terms—by the rivalry between "the German method" of Samuel Heinicke and "the French method" of Charles-Michel de l'Épée. The oral method propelled studies of the material voice, alongside protocols for lip-reading and articulation, and devices for synthesizing speech. The speech versus sign debate provided the foundation for the modern distinction between two deaf identities: deaf and Deaf, respectively.

In the nineteenth century, European methods for deaf education were exported around the world, often as a result of missionary work. In 1817, Thomas Gallaudet brought the French model and a deaf student from l'Épée's school to the United States. Gallaudet and the student, Laurent Clerc, founded the American School for the Deaf in Hartford, Connecticut. An American Sign Language (ASL) emerged at this site through the mixing of French, local, and home signs (gestures developed for communication on an ad hoc basis within families without formal sign language). Most of the deaf schools founded in the United States immediately thereafter also offered instruction in sign language. These residential schools—

with their ASL communities, publications, and traditions—incubated what became known, in the following century, as American Deaf culture.

By the 1860s, however, oralism began to prevail in the school system, partly through misguided Darwinism. Sign language, previously believed to be a natural and even uncorrupted human language, suddenly seemed "primitive" (Baynton 1996: 42). Speech became the primary feature that distinguished humans from the other animals. At the same time, studies of speech and hearing multiplied with the rise of phonetics, the pedagogical sciences, and the medical specialties of otology and laryngology. In the post–Civil War era, sign language instruction also suffered as the result of widespread demands for a unified national language. In 1880, when the International Conference of Teachers of the Deaf met in Milan, those present—mostly oralists—voted to advance a "pure" oral method on a global scale. Sign language would not even be a supplement; it had been reconceived as detrimental to oral education and even to rationality.[4] Although the classification of students in U.S. oral schools had previously included such categories as deaf, semi-deaf, deaf-mute, and semi-mute, oralists increasingly rejected the term "mute."

The best-known advocate of oralism from this time period is surely Alexander Graham Bell—now a canonical figure in sound studies. In 1871, Bell moved to the United States from Canada (his family had previously emigrated from Britain) to teach at the Boston School for Deaf Mutes. At the outset, he taught lip-reading and articulation with the aid of the Visible Speech system created by his father, Alexander Melville Bell. A founder of modern phonetics, Melville Bell had followed his own father into the field of elocution, and his wife—Graham Bell's mother—was deaf. Melville Bell developed an iconic script, or "physiological alphabet," for representing the positions of the vocal organs during the production of speech sounds. He foresaw this Visible Speech as an aid for streamlining spelling, in any language, and for teaching articulation to deaf people.

Melville Bell also saw in the science of phonetics the key to the design of new sound technologies: "Scientific men . . . have elaborated theories of optics—and look at the result? Wonderful mechanical adaptations of optical principles, before undreamt of, and which, otherwise, would never have been discovered. Might not an analogous result attend the philosophical investigation of the faculty of speech; and acoustic and articulative principles be developed, which would lead to mechanical inventions no less wonderful and useful than those in optics?" (1916: 41). John

Durham Peters proposes that we think of modern technical media and psychotechnical interfaces as cases of "applied physiology" (Peters 2004). Indeed, the telephone eventually built by Graham Bell made use of the "tympanic principle" of the human middle ear to transfer speech vibrations to an electrical current (Sterne 2003). The telephone was preceded by Bell's work on an "ear phonoautograph," a second generation Visible Speech machine that used an actual eardrum, attached to a stylus, to inscribe speech waves on a plate of sooted glass. Graphic inscription was known as the "universal language of science" in the 1800s for its ability to visualize the waveforms of which all the world's motions and sensory phenomena seemingly consisted. Graham Bell had hoped the phonoautograph would assist his investigations into the nature of vowels, and also supply visual feedback to his students (one of whom he married) as they practiced their articulation. As Hans Günter Tillmann explains, regarding the new phonetics, "it was assumed, first, that speech could be exhaustively investigated as a purely mechanical process, and secondly that the listener could be replaced by a deaf observer" (Tillman 1995: 402).

Later in his career, Graham Bell would also play a formative role in the emerging biopolitical approach to deafness. He became interested in eugenics as a means of "positive" population management; after conducting genealogies of deaf families and surveys of deafness in schools, he advocated deafness prevention through measures such as hygiene and bans on intermarriage among those born deaf. Bell's eugenics is an extreme example of what Tom Humphries calls "audism": the privileging of speech and hearing to the point of discrimination against those who are deaf, and especially those who communicate via sign (Humphries 1977).

Beginning in the nineteenth century, occupational hearing loss—induced by noise—attracted increasing medical interest (Dembe 1996). The development of electronic audiometry in the 1920s facilitated the medicalization of deafness—the creation of a "normal curve" for hearing and a new set of physiological categories by which deafness was named. Medicalization gained broad momentum in this time period, as medical jurisdiction expanded over matters previously considered to be educational, legal, or religious. In the United States, the "medicalization" of deafness resulted from a collaboration between physicians, social workers, and the telephone company; the latter supplied the electronic equipment for school audiometry and for the first National Health Surveys of hearing in 1936. Although statistics emerged as a discipline in the

nineteenth century—at a time when tuning fork tones and watch ticks were used to gauge impairment—the "parametrization" of hearing did not take place until electronic audiometers afforded precise control over the volume and frequency of sound. The National Health Survey established a preliminary "reference zero" for hearing; along with this norm came graded categories of *hearing loss*: that is, mild, moderate, severe, and profound impairment.[5] These categories were at once individualizing and relative; rather than evoke identity or collectivity, they defined the individual as a variant of a population.[6]

In the early 1900s, activists at the New York League for the Hard of Hearing began to insist on a distinction between those born deaf and raised in institutions, whether signing or oral, and those who were *deafened* later in life, whether in part or in full. Prior to the twentieth century, adults with late hearing loss tended to be described simply as deaf or semi-deaf. "Hardness of hearing" was a euphemism in both instances. League members argued that "the deafened" required medical and paramedical interventions—surgery, prosthesis, speech therapy—to correct their "adventitious" impairments, which they contrasted to innate "defects." The League petitioned for hearing loss to be recognized as a military disability in 1918. In turn, the rehabilitation policies of the Veterans' Bureau, aimed at returning people with disabilities to work, would spur the prosthetic and therapeutic fields.

Deafening became a vast—and vastly salient—concept in the early twentieth century, fueled by a parallel discourse on noise. Audio engineers and noise reformers alike became concerned with noise-related hearing loss, which might be situational (occurring over radio sets and telephone lines) or literal (caused by earsplitting factories, battlegrounds, and urban centers). No longer defined by silence and alienation, deafness became associated with noise, immersion, masking, and inefficiency. Disability per se was not universalized, however: physical impairment remained distinct from situational deafening, as did "normal limitations" from actual disabilities.

The shift of deafness from a state of dissimilarity or philosophical curiosity to one of quantifiable deficit from a norm dovetailed, around World War I, with the aims of the rehabilitation movement. Audiometry facilitated treatment as well as tracking in the school system. Childhood screenings identified as "hearing impaired" children who might otherwise be considered deaf and educated in sign language; with the advent of wearable vacuum tube hearing aids in the 1930s, those children were increasingly mainstreamed.

Taken together, the rise of oral institutions and the mainstreaming of students with "moderate impairments" worked against the formation of sign language communities in residential schools (Baynton 1996: 94).[7]

Many deaf people, of course, continued to use sign language outside the classroom. Moreover, as part of the civil rights movement in the latter half of the twentieth century, many members of the sign language community began to insist that their "disability" was socially constructed, the result of stigma and barriers in the built environment. James Woodward proposed the concept of Deaf culture in 1972, capitalizing the term to distinguish the linguistic minority definition from the audiological one (Woodward 1972). As Harlan Lane clarifies, "late deafening and moderate hearing loss tend to be associated with the disability construction of deafness while early and profound deafness involve an entire organization of the person's language, culture, and thought around vision and tend to be associated with the linguistic minority construction" (Lane 2006: 80). The linguistic approach expanded the category of deafness: hearing children of deaf adults (CODAs) might also be Deaf, if they used sign language and participated in this minority culture.

The following decade, FDA approval of the cochlear implant commenced the biomedicalization of deafness; this electronic device transduces and processes environmental sounds, transmitting corresponding signals directly to the auditory nerve. While cochlear implant users are technically deaf, their audiograms post-implant may be comparable to those who are hard of hearing. In general, the boundary between deafness and hearing is now impossible to pinpoint. As human longevity increases, and as individuals are exposed to amplified sounds for significant fractions of their lives, hearing loss has become the norm.

That many electronic and acoustic innovations since the late nineteenth century are indebted to deafness—for example, telephones, carbon microphones, subminiature vacuum tubes, sound spectrography, closed captioning—is an indication of the commonness of hearing impairment, especially in an increasingly complex media ecology where "good communication" is narrowly defined. Several well-known inventors of audio-related technologies have themselves identified as deaf or hard of hearing (e.g., Thomas Edison, Oliver Heaviside, John Ambrose Fleming). Deafness has afforded insights into otology, acoustics, and phonetics, and in turn given rise to new psychotechnical devices. "Assistive" technologies designed for deaf and hard of hearing people have been repurposed for broad use. In still other cases,

deaf users have appropriated mainstream audio technology: telephones have been turned into hearing aids; radio receivers have become tactile interfaces; videophones have been employed for long-distance signing.

The prevalence of deafness in the invention and development of telegraph, telephone, radio, Internet, and microelectronic technology has led historians to see disability as one of the "conditions of possibility" for modern media. In Friedrich Kittler's words, "handicaps"—especially deafness and blindness—"stood at the beginning of all media technology" (2006: 45). Yet even when deafness is conjured in this hyperbolic manner, it rarely features as more than a metaphor or exemplar.

In 2003, Jonathan Sterne observed that the field of sound studies had largely failed to incorporate the insights of Deaf and disability theory: "scholars of speech, hearing, and sound seem largely ignorant of the cultural work on deafness" (2003: 346). At present, a few authors have centered deafness in their accounts. In "Sound Studies Meets Deaf Studies" (2012), Michele Friedner and Stefan Helmreich enumerate several Deaf practices that enlarge the standard definitions of sound and listening. Deaf people, for instance, "infer sound" through observations of hearing behaviors. The deaf and the hearing alike experience low-frequency sound in the tactile register. Parallel to this emerging scholarship, deaf sound artists have worked to denaturalize hearing and otherwise-invisible communication infrastructures. As one example, Christine Sun Kim manipulates sound as a tool to teach her audiences to "unlearn sound etiquette."[8] Likewise, Hillel Schwartz chastises scholars of sound who posit hearing as "an invariable physiology: the sounds people hear may change, and their reactions to those sounds do change, but how people hear remains the same" (Schwartz 2011: 22). In *Making Noise*, he enumerates the ways human hearing varies—among individuals and across time periods—as a result of disease and nutrition; medicine and education; architecture and fashion; occupation and recreation; manner and law.

The history of deaf communication makes clear that sound is always already multimodal. Sound waves transfer between media (air, water, solids), and can be experienced by sensory domains beyond the ear. Vibrations, visual recordings, and speech gestures are all possible components of an acoustic event. The ear itself is a composite organ, which hears by mechanical and electrical means. Although attention to hearing difference has yet to become a regular feature of sound studies, deaf and hard of hearing people have long testified to the heterogeneity of ear-listening.

Joseph Furnas, historian and hearing aid wearer, wrote about his experience of "forty percent hearing" in the mid-twentieth century: navigating echoes in rooms with hard surfaces; seeking good lighting for speechreading; missing words and lines; picking up clothing noise and the buzz of neon lights with a body-worn hearing aid (1957). More recently, cochlear implant users like Michael Chorost describe the experience of electrical hearing: learning to correlate electronic sounds to speech and environmental noises; listening to music imperfectly rendered through a speech processor; picking up noise from electrical fields; listening to sounds that never exist as airborne waves, by connecting an implant directly to another electronic device (2005). Deafness is thus a variety of hearing; alternately, it can be conceived as a precondition of hearing or as the resistance to hearing and audism.

Notes

1. See the Deaf Space page of the Gallaudet University website, www.gallaudet.edu/Campus_Design/DeafSpace.html.

2. In contrast, today those with a 56- to 70-decibel hearing loss in the speech frequency range are considered to have only "moderately severe impairment." Although they cannot hear speech unaided, electronic amplification enables oral communication; here technology has transformed the classification system.

3. Bone conduction hearing aids pass sound waves to the auditory nerve through the teeth or skull.

4. As the second resolution from the conference stated, "the simultaneous use of speech and signs has the disadvantage of injuring speech, lipreading and precision of ideas."

5. Deafnesses also varied in kind: one might have hearing loss in the high or low frequency ranges; the cause might be traced to the middle or the inner ear; tinnitus or ringing might be the primary symptom.

6. For a more detailed critique of audiometric classification systems, and their industrial and legal applications, see Clark.

7. In 1975, the Education for All Handicapped Children Act formally encouraged mainstream schooling, with accommodations, over deaf-only institutions.

8. See Sun Kim's website, www.christinesunkim.com.

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[5] Mark M. Smith

echo

Writing Sound History

An echo is nothing if not historical. To varying degrees, it is a faded facsimile of an original sound, a reflection of time passed. It invites a habit of listening that not only allows us to locate origin (temporally and spatially) but, more important, test authenticity: how illustrative the sound was of the historical moment in which it was produced. The acoustic world in which echoes are generated after the original ring, bang, vocal moment—sound generally—is, inherently, a historical world. For this reason, historians, either consciously or unwittingly, think and write about echoes when analyzing sounds of the past (M. Smith 2002).

To what extent the echo can, does, or should have fidelity to the original sound is a question preoccupying historians of any period. Put simply, how, if at all, do historians hear, say, the boom of cannon during the American Civil War, the clang of bells in the nineteenth-century French countryside, or urbanization in the twentieth century? Plainly, the sounds generated in the past—in the years, months, weeks, even moments removed from the present—*seem* ephemeral and, for most of human history, were not subject to electromagnetic recording. As Bruce Smith has written, "for an historian interested in the sounds of the past, there would seem to be nothing *there* to study, at least until the advent of electromagnetic recording devices early in the twentieth century" (B. Smith 2002: 307). This assumption regarding the ephemerality of sound and its tight tethering to technologies of recording has proven seductive. It has veined the very epistemology of some historical thinking. Several historians invite us to write about both the electromagnetically recorded and unrecorded sounds of the past either by exercising what they call the historical imagination or by trying to reexperience the sound through a sort of performative reenactment.

This tendency courts a number of questions central to the epistemology and ontology of what we might think of as *historical acoustemology*.