The Soundscape of Modernity

Architectural Acoustics and the Culture of Listening in America, 1900-1933

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In this history of aural culture in early-twentieth-century America, Emily Thompson charts dramatic transformations in what people heard and how they listened. What they heard was a new kind of sound that was the product of modern technology. They listened as newly critical consumers of aural commodities. By examining the technologies that produced this sound, as well as the culture that enthusiastically consumed it, Thompson recovers a lost dimension of the Machine Age and deepens our understanding of the experience of change that characterized the era.

Reverberation equations, sound meters, microphones, and acoustical tiles were deployed in places as varied as Boston's Symphony Hall, New York's office skyscrapers, and the soundstages of Hollywood. The control provided by these technologies, however, was applied in ways that denied the particularity of place, and the diverse spaces of modern America began to sound alike as a universal new sound predominated. Although this sound--clear, direct, efficient, and nonreverberant--had little to say about the physical spaces in which it was produced, it speaks volumes about the culture that created it. By listening to it, Thompson constructs a compelling new account of the experience of modernity in America.

เอกสารประกอบการประชุมศุกร์เสวนา วันที่ 13 มิถุนายน 2551 Emily Thompson. (2002). Introduction: Sound, Modernity and History.*The Soundscape of Modernity: Architectural Acoustics and Culture of Listening in America, 1900-1933*. USA: The MIT Press.

CHAPTER 1 INTRODUCTION: SOUND, MODERNITY, AND HISTORY

The Soundscape of Modernity is a history of aural culture in early twentieth-century America. It charts dramatic transformations in what people heard, and it explores equally significant changes in the ways that people listened to those sounds. What they heard was a new kind of sound that was the product of modern technology. They listened in ways that acknowledged this fact, as critical consumers of aural commodities. By examining the technologies that produced those sounds, as well as the culture that consumed them, we can begin to recover more fully the texture of an era known as "The Machine Age," and we can comprehend more completely the experience of change, particularly technological change, that characterized this era.

By identifying a soundscape as the primary subject of the story that follows, I pursue a way of thinking about sound first developed by the musician R. Murray Schafer about twenty-five years ago. Schafer defined a soundscape as a sonic environment, a definition that reflected his engagement with the environmental movements of the 1970s and emphasized his ecologically based concern about the "polluted" nature of the soundscape of that era.[1] While Schafer's work remains socially and intellectually relevant today, the issues that influenced it are not what has motivated my own historical study, and I use the idea of a soundscape somewhat differently. Here, following the work of Alain Corbin, I define the soundscape as an auditory or aural landscape. Like a landscape, a soundscape is simultaneously a physical environment and a way of perceiving that environment; it is both a world and a culture constructed to make sense of that world.[2] The physical aspects of a soundscape consist not only of the sounds themselves, the waves of acoustical energy permeating the atmosphere in which people live, but also the material objects that create, and sometimes destroy, those sounds. A soundscape's cultural aspects incorporate scientific and aesthetic ways of listening, a listener's relationship to their environment, and the social circumstances

that dictate who gets to hear what.[3] A soundscape, like a landscape, ultimately has more to do with civilization than with nature, and as such, it is constantly under construction and always undergoing change. The American soundscape underwent a particularly dramatic transformation in the years after 1900. By 1933, both the nature of sound and the culture of listening were unlike anything that had come before.

The sounds themselves were increasingly the result of technological mediation. Scientists and engineers discovered ways to manipulate traditional materials of architectural construction in order to control the behavior of sound in space. New kinds of materials specifically designed to control sound were developed, and were soon followed by new electroacoustic devices that effected even greater results by converting sounds into electrical signals. Some of the sounds that resulted from these mediations were objects of scientific scrutiny; others were the unintended consequences—the noises—of an ever-more mechanized society; others, like musical concerts, radio broadcasts, and motion picture sound tracks, were commodities consumed by an acoustically ravenous public. The contours of change were the same for all.

Accompanying these changes in the nature of sound were equally new trends in the culture of listening. A fundamental compulsion to control the behavior of sound drove technological developments in architectural acoustics, and this imperative stimulated auditors to listen more critically, to determine whether that control had been accomplished. This desire for control stemmed partly from new worries about noise, as traditionally bothersome sources of sound like animals, peddlers, and musicians were increasingly drowned out by the technological crescendo of the modern city. It was also driven by a preoccupation with efficiency that demanded the elimination of all things unnecessary, including unnecessary sounds. Finally, control was a means by which to exercise choice in a market filled with aural commodities; it allowed producers and consumers alike to identify what constituted "good sound," and to evaluate whether particular products achieved it.

Perhaps the most significant result of these physical and cultural changes was the reformulation of the relationship between sound and space. Indeed, as the new soundscape took shape, sound was gradually dissociated from space until the relationship ceased to exist. The dissociation began with the technological manipulations of sound-absorbing building materials, and the severance was made complete when electroacoustic devices claimed sound as their own. As scientists and engineers engaged increasingly with electrical representations of

acoustical phenomena, sounds became indistinguishable from the circuits that produced them. When electroacoustic instruments like microphones and loudspeakers moved out of the laboratory and into the world, this new way of thinking migrated with them, and the result was that sounds were reconceived as signals.

When sounds became signals, a new criterion by which to evaluate them was established, a criterion whose origins, like the sounds themselves, were located in the new electrical technologies. Electrical systems were evaluated by measuring the strength of their signals against the inevitable encroachments of electrical noise, and this measure now became the means by which to judge all sounds. The desire for clear, controlled, signal-like sound became pervasive, and anything that interfered with this goal was now engineered out of existence.

Reverberation, the lingering over time of residual sound in a space, had always been a direct result of the architecture that created it, a function of both the size of a room and the materials that constituted its surfaces. As such, it sounded the acoustic signature of each particular place, representing the unique character (for better or worse) of the space in which it was heard. With the rise of the modern soundscape this would no longer be the case. Reverberation now became just another kind of noise, unnecessary and best eliminated.

As the new, nonreverberant criterion gained hold, and as the architectural and electroacoustic technologies designed to achieve it were more widely deployed, the sound that those technologies produced now prevailed. The result was that the many different places that made up the modern soundscape began to sound alike. From concert halls to corporate offices, from acoustical laboratories to the soundstages of motion picture studios, the new sound rang out for all to hear. Clear, direct, and nonreverberant, this modern sound was easy to understand, but it had little to say about the places in which it was produced and consumed.

This new sound was modern for a number of reasons. First, it was modern because it was efficient. It physically embodied the idea of efficiency by being stripped of all elements now deemed unnecessary, and it exemplified an aesthetic of efficiency in its resultant signal-like clarity. It additionally fostered efficient behavior in those who heard it, as the connection between minimized noise and maximized productivity was convincingly demonstrated. Second, it was modern because it was a product. It constituted a commodity in a culture increasingly defined by the act of consumption, and was evaluated by listeners who tuned their ears to the sounds of the market. Finally, it was modern because it was per-

ceived to demonstrate man's technical mastery over his physical environment, and it did so in a way that transformed traditional relationships between sound, space, and time. Technical mastery over nature and the annihilation of time and space have long been recognized as definitive aspects of modern culture. From cubist art and Einsteinian physics to Joycean stream-of-consciousness storytelling, modern artists and thinkers were united by their desire to challenge the traditional bounds of space and time. Modern acousticians shared this desire, as well as the ability to fulfill it. By doing so, they made the soundscape modern.

Telling the story of the complicated transformations outlined above presents its own challenge to the writer who strives to control a narrative that moves through historical time and space. The story that follows begins in 1900 and ends in 1933, but it traverses this chronological trajectory several times over, returning to the start to explore new themes and phenomena, reexamining recurrent phenomena along the way, reiterating central themes, and ultimately—I hope—creating a resounding whole in which all the disparate elements combine to characterize fully and compellingly the construction of the modern soundscape.

I begin at the turn of the century with opening night at Symphony Hall in Boston, and I end with Radio City Music Hall in New York, which opened just as the Machine Age in America came to a grinding halt at the close of 1932. Symphony Hall was a secular temple in which devout listeners gathered to worship the great symphonic masterpieces of the past, particularly the music of Ludwig van Beethoven, whose name was inscribed in a place of honor at the center of the gilded proscenium. Radio City Music Hall, in contrast, was a celebration of the sound of modernity. Its gilded proscenium was crowned, not with the name of some long-dead composer, but with state-of-the-art loudspeakers that broadcast the music of the day to thousands of auditors gathered beneath it.

Yet, even as Symphony Hall was dedicated to the music of the past, it heralded a new acoustical era, an era in which science and technology would exert ever-greater degrees of control over sound. Symphony Hall was recognized as the first auditorium in the world to be constructed according to laws of modern science. Indeed, it not only embodied, but instigated, the origins of the modern science of acoustics. When a young physicist at Harvard University named Wallace Sabine was asked to consult on the acoustical design of the hall, he responded by developing a mathematical formula, an equation for predicting the acoustical quality of rooms. This formula would prove crucial for the subsequent transformation of the soundscape into something distinctly modern.

While Radio City Music Hall was intended to celebrate that soundscape, facing optimistically toward the future rather than gazing longingly back at the past, it actually signaled the end of this period of change. Radio City demonstrated an unprecedented degree of control over the behavior of sound, but this demonstration was no longer compelling in a culture now facing far greater challenges. In America in 1933, the technological enthusiasm that had fed the long drive for such mastery was fundamentally shaken. The Machine Age was over, and Radio City was immediately recognized as a relic of that bygone era.

Since Wallace Sabine's work on Symphony Hall was recognized at the time as something distinctly new, it must be examined closely in order to understand its significance for what would follow. Chapter 2 presents this examination by exploring the scientific details of Sabine's research and his application of those results to the design of Symphony Hall. The equations and formulas he developed are crucial historical artifacts for the story that follows and it would be inappropriate not to include them, but their importance will be fully explained in nonmathematical prose, for readers not accustomed to confronting scientific equations.

Just as important for understanding the nature and reception of Sabine's work is the context in which it took place, so chapter 2 also presents a brief survey of earlier efforts to control sound, and it considers why Sabine's work was perceived to be valuable by both architects and listeners. Finally, an examination of the critical reception of the acoustics of Symphony Hall demonstrates the complicated combination of social, cultural, and physical factors that go into the process of defining, as well as creating, "good sound."

Chapters 3 through 6 cover the period 1900–1933 from four different perspectives. Chapter 3 focuses on the work of the scientists who, following Sabine's lead, devoted their careers to the study of sound and its behavior in architectural spaces. Like Sabine before them, these men were initially frustrated by a lack of suitable scientific tools for measuring sound. With the development of new electrical instruments in the 1920s, not only did it become possible to measure sound, but the tools also stimulated new ways of thinking about it. Scientists drew conceptual analogies between the sounds that they studied and the circuits that measured those sounds, and the result was a new interest in the signal-like aspects of sound. By 1930, new tools, new techniques, and a new language for describing sound had fundamentally transformed the field of acoustics. "The New Acoustics" was proclaimed, and its success as a science and a profession was acknowledged with the founding of the Acoustical Society of America.

The New Acousticians of the modern era sought a larger sphere in which to apply their science, to attract public attention to that science and to earn respect for their expertise and their efforts. The problem of city noise provided a challenging and highly visible forum. Chapter 4 thus moves out into the public realm and charts changes in the problem and meaning of noise.

While noise has been a perennial problem throughout human history, the urban inhabitants of early-twentieth-century America perceived that they lived in an era unprecedentedly loud. More troubling than the level of noise was its nature, as traditional auditory irritants were increasingly drowned out by the din of modern technology: the roar of elevated trains, the rumble of internal combustion engines, the crackle and hiss of radio transmissions. As the physical nature of noise changed, so, too, did attempts to eliminate it. At the turn of the century, noise abatement was a type of progressive reform where influential citizens attempted to legislate changes in personal behavior to quiet the sounds of the city. As the sounds of modern technology swelled, it became clear that only technical experts could quell these sounds, and in the 1920s, acousticians were called upon to reengineer the harmony of the modern city.

While the majority of those who engaged with noise sought to eliminate it, some were stimulated more creatively by the sounds that surrounded them. The modern soundscape was filled with music as well as noise, and chapter 4 considers how both jazz musicians and avant-garde composers redefined the meaning of sound and the distinction between music and noise. Acousticians did much the same thing, but with scientific, rather than musical, instruments.

Noise abating engineers ultimately failed, however, to master the modern urban soundscape. Their new ability to measure noise only amplified the problem and did not translate into a solution within the public sphere of legislation and civic action. Nonetheless, a private alternative would succeed where this public approach did not, and chapter 5 retreats back indoors to consider how the technology of architectural acoustics was deployed to alleviate the problem of noise and to create a new modern sound.

Chapter 5 follows the rise of the acoustical materials industry, charting the development of a range of new building technologies dedicated to isolating and absorbing sound. Acousticians devised new materials and supervised their installation in offices, apartments, hospitals, and schools, as well as in traditional places of acoustical design like churches and auditoriums. These sound-engineered buildings offered refuge from the noise without, and transformed quiet from an unenforceable public right into a private commodity, available for purchase by anyone who could afford it.

Acoustical building materials demonstrated technical mastery over sound and embodied the values of efficiency. By minimizing reverberation and other unnecessary sounds, the materials created an acoustically efficient environment and engendered efficient behavior in those who worked within it, and began the process by which sound and space would ultimately be separated. Through a series of case studies of representative materials and the buildings in which they were installed, chapter 5 will describe the architectural construction of modern sound and will conclude by demonstrating how that sound made an integral contribution to the establishment of modern architecture in America.

With the silencing of space came a desire to fill it with a new kind of sound, the sound of the electroacoustic signal. Chapter 6 examines how electroacoustic technology moved out of the lab and into the world, and, by returning to performance spaces, emphasizes how much things had changed since 1900. Microphones, loudspeakers, radios, public address systems, and sound motion pictures now filled the soundscape with new electroacoustic products. Consumers of those products, like acoustical scientists and engineers, learned to listen in ways that distinguished the signals from the noise. This distinction became a basis for defining what constituted good sound: clear and controlled, direct and nonreverberant, denying the space in which it was produced.

This modern sound was not exclusively the product of electrical technologies, and it was constructed architecturally in auditoriums where loudspeakers were neither required nor desired. Nonetheless, most Americans heard this sound most often on the radio or at the movies, and chapter 6 focuses on the transformation of motion picture theaters and studios as both were wired for sound.

The technologies of electroacoustic control that were developed in the sound motion picture industry highlighted questions about the relationship between sound and space, forcing sound engineers and motion picture producers alike to decide just what their new sound tracks should sound like. The technology also provided new means by which to construct the sound of space, as engineers learned to create electrically a spatialized sound that we would call "virtual." The sound of space was now a quality that could be added electrically to any sound signal in any proportion; it no longer had any relationship to the physical spaces of architectural construction. This new sound bore little resemblance to that which had been heard in 1900. It was so different, Wallace Sabine's fundamental reverberation equation failed to describe it. Sabine's equation was revised to fit the modern soundscape, and with this revision, the transformation was complete.

The revision of Sabine's equation expressed the transformation of the soundscape in a cryptic mathematical language that spoke only to acousticians and sound engineers. That same transformation was more widely and unmistakably heard in the sounds and structures of Rockefeller Center, and *The Soundscape of Modernity* closes by examining the critical reception of the center in order to understand the conclusion of the era that defined the modern sound.

From the office spaces of the RCA tower to the NBC studios to the auditorium of Radio City Music Hall, the modern soundscape was epitomized and celebrated. Even before the construction of the center was complete, however, such celebration was immediately perceived to be inappropriate and outdated. New economic conditions and new attitudes regarding the previously unquestioned promise of modern technology brought the era of modern acoustics to a close. The Machine Age was now over, and the modern soundscape would begin to transform itself again into something new.

With the basic outline of the story in place, it is useful to consider briefly how this story will relate to others doubtlessly more familiar to its readers. What does *The Soundscape of Modernity* accomplish, beyond providing a sound track to a previously silent historiography? Most basically, my story builds and expands upon past histories of the science and technology of acoustics. Much of this work has been written by practitioners, and they have constructed a solid foundation upon which I have built my own understanding of the intellectual developments of the field.[4] Historians of science have only recently begun to turn their attention to the science of sound, and have so far focused on periods that precede my own.[5] These studies have offered important insights into general questions concerning the rise of modern science and the role of scientific instruments in its creation. The history of twentieth-century acoustics similarly addresses fundamental questions about the relationships between science, industry, and the military, and it elucidates the instrumental connections between the material culture of science and its intellectual accomplishments.[6] My work only begins to examine these issues, but it demonstrates the fruitfulness of the history of acoustics in a way that may encourage others to follow.

As a contribution to the history of technology, my story is situated at the intersection of two different, but equally important, strands of scholarship. While some of the best work in this field has been devoted to the history of radio, the accomplishments of Hugh Aitken and Susan Douglas have recently been complemented by the output of an emerging community of scholars focusing upon

a whole range of technological topics associated with music and sound.[7] My work adds architectural acoustics to this mix, but perhaps more importantly addresses the history of listening in a way that may influence our understanding of the entire range of acoustical technologies currently being explored.[8]

The environmental trend in the history of technology is equally vibrant and particularly valuable for its consideration of the urban context.[9] My examination of the problem of noise in American cities builds upon the work of others who have explored this phenomenon, but my perspective is distinct. Instead of drawing upon late-twentieth-century concerns about pollution and the degradation of the environment, I turn instead to the cultural meaning of noise in the early decades of the century, to demonstrate how musicians and engineers created a new culture out of the noise of the modern world.[10] By doing so, I hope to argue more generally that culture is much more than an interesting context in which to place technological accomplishments; it is inseparable from technology itself.

The history of acoustics intersects with the history of the urban environment not only through the problem of city noise, but also through technologies of architectural construction, and my work addresses an aspect of construction long neglected by visually oriented architectural historians. I challenge these historians to listen to, as well as to look at, the buildings of the past, and I thereby suggest a different way to understand the advent of modern architecture in America. As an outsider to this field, I leave it to others to evaluate the usefulness of my approach and its conclusions.[11]

I am similarly an outsider to the field of film studies, but some of the most interesting and thoughtful work on the history of sound technology and the culture of listening is found here, and my own work has benefitted enormously from the insights of this scholarship.[12] Still, here, as in architectural studies, many historians continue to operate with a predominantly visual orientation, understanding sound film primarily in its relation to the earlier traditions of silent film production. In contrast, I approach sound film from the perspective of the wider range of acoustical technologies that were developed and deployed alongside it. By doing so, I am able to demonstrate that, in deciding what sound film should sound like, filmmakers functioned in a larger cultural sphere. The decisions they made reflected not only the conditions of their own industry, but the larger soundscape in which that industry flourished.

Any exploration of a soundscape should ultimately inform a more general understanding of the society and culture that produced it. The reverberations of

aural history within the larger intellectual framework of historical studies are just beginning to be heard, but the successes already accomplished speak well for the future of this approach. Leigh Schmidt, for example, has examined the meaning of sound in the American Enlightenment, and has thereby not only recovered the sensory experience of religion in American history, but also documented the forging of both science and popular culture out of those experiences. Mark Smith has identified a previously unacknowledged site of sectional tension in antebellum America by reconstructing the soundscapes of slaves, masters, and abolitionists.[13] And such studies of soundscapes are by no means limited to the American context. Bruce Smith has restored the lost sound of Shakespearian drama as it originally reverberated through the Globe Theatre and across Early Modern England, and in those reverberations he hears the transition from oral to literate culture. James Johnson has detected the rise of romanticism and bourgeois sensibility within the soundscape of the French concert hall, and Alain Corbin has perceived in the peals of village bells in nineteenth-century France the changing structures of religious and political authority.[14]

Clearly, these histories have much to say about the larger historical processes at work within their soundscapes, and all highlight themes and issues that historians have long considered to be constitutive of the rise of modern society and culture in the West.[15] Until recently, that long-term process of modernization was perceived as a particularly visual one, but the new aural history now demonstrates that, to paraphrase Schmidt, there is more to modernity than meets the eye.[16] This is particularly true for the period of so-called high modernism, and the long-standing absence of the aural dimension in cultural histories of the late nineteenth and early twentieth centuries is perhaps most striking of all.

"Modernism has been read and looked at in detail but rarely heard," concludes Douglas Kahn, in spite of the fact that this culture "entailed more sounds and produced a greater emphasis on listening to things," and on "listening differently" than ever before.[17] Those new sounds, and that different way of listening, were created and constructed through new acoustical technologies. James Lastra also asserts that "the experience we describe as 'modernity'—an experience of profound temporal and spatial displacements, of often accelerated and diversified shocks, of new modes of society and of experience—has been shaped decisively by the technological media."[18] To exclude acoustical technologies and sound media from scrutiny is to miss the very nature of that experience. Scholars who assume that consideration of the visual and textual is sufficient for understanding modernity, seem, well, shortsighted to say the least.

Restoring the aural dimension of modernity to our understanding of it promises not only to render that understanding "acoustically correct," it also provides a means by which to understand, more generally and significantly, the role of technology in the construction of that culture. This, after all, was the era in which the adjective *modern* achieved a new resonance through the self-conscious efforts of artists, writers, musicians, and architects, all of whose work was characterized by a pervasive engagement with technology.

Histories of modernism have long recognized the importance of technology as inspiration to the artists who are credited with creating the new culture. But these histories have too seldom engaged with technology as intensely as did those artists. Too often, the machines of the Machine Age are characterized as the uninteresting products of naive engineers that only achieved cultural significance when transmitted through the lens of art. "The impact of technology" upon these artists, not the technology itself, is what drives these accounts.[19]

It is not my intent to deny the importance of those artists and their work; indeed their music and architecture are crucial elements of the story that follows. But by juxtaposing the creations of mundane engineers with those of extraordinary artists, I implicitly argue that the works of both were equally significant and equally modern. Unremarkable objects like sound meters and acoustical tiles have as much to say about the ways that people understood their world as do the paintings of Pablo Picasso, the writings of John dos Passos, the music of Igor Stravinsky, and the architecture of Walter Gropius. All are cultural constructions that epitomized an era defined by the shocks and displacements of a society reformulating its very experience of time and space.

Karl Marx had these displacements in mind when he famously summarized the condition of modernity by proclaiming, "All that is solid melts into air."[20] Marx had very particular ideas about the material aspects of life and their role in historical change, ideas not necessarily at play in the story that follows. Nonetheless, like Marx, I believe that the essence of history is found in its material. I argue against the idea of modernity as a cultural zeitgeist, a matrix of disembodied ideas perceived and translated by great artists into material forms that then trickle down to a more popular level of consciousness. In the story that follows, modernity was built from the ground up. It was constructed by the actions and through the experiences of ordinary individuals as they struggled to make sense of their world.[21]

If modern culture is not a zeitgeist, not an immaterial cluster of ideas somehow "in the air," it must be acknowledged that sound most certainly is there, in

the air. This ephemeral quality of sound has long frustrated those who have sought to control it, and the architect Rudolph Markgraf expressed the frustrations of many when he complained in 1911 that "sound has no existence, shape or form, it must be made new all the time, it slumbers until it is awaken[ed], and after it ceases its place of being it is unknown."[22] Markgraf was perplexed by "the mysteries of the acoustic," and historians of soundscapes are similarly challenged by sound's mysterious ability to melt into air, its tendency—even in a postphonographic age—to efface itself from the historical record. But if most sounds of the past are gone for good, they have nonetheless left behind a rich record of their existence in the artifacts, the people, and the cultures that once brought them forth. By starting here, with the solidity of technological objects and the material practices of those who designed, built, and used them, we can begin to recover the sounds that have long since melted into air. Along with those sounds, we can recover more fully our past.