

# INTRODUCTION

## “THE NIGHT SHALL BE FILLED WITH MUSIC”

UNTIL RELATIVELY RECENTLY, THE MOST SOPHISTICATED SONIC MEDIA were buildings. The acoustic properties of a building can facilitate or frustrate the activity it houses, whether conversation, artistic performance, or ritual. A room may seem monumental or intimate depending on its level of reverberation. Architecture often contains secret places where sounds echo or voices carry in surprising ways. All these acoustic conditions can have political consequences, determining whose words are heard and by whom. Sound matters not just in specialized buildings such as auditoria and concert halls but in almost every kind of structure. Yet the discourse of architecture often struggles to engage critically with the sonic life of buildings. Presented in arid scientific terms, acoustics can seem peripheral to the discipline’s core concerns.

This book offers an *architectural* history of architectural acoustics, positioning it as a central problem for the field. It also argues that the elaboration of architectural acoustics helped provide modern culture with words, representational conventions, and intellectual frameworks for conceiving sound spatially. After all, sound takes place. To hear a sound is, with few exceptions, to perceive its arrival *from somewhere*. While humans’ ability to recognize locational cues in sound is a biological faculty based in the auditory cortex, how one interprets these cues is culturally determined—bound up with social and linguistic practices, habits of mind and body, sensory

hierarchies, artistic forms, communication technologies, even religious commitments. It is connected in especially significant ways with architecture.

In recent years, the most important social and cultural accounts of sound in the physical environment have drawn on the idea of *acoustic space*. This locution and related terms such as *soundscape* have appeared more and more frequently in writing about architecture, not to mention scholarship in media and communication studies, musicology, literary studies, anthropology, and art history. Yet “acoustic space” elides several distinct meanings. It is sometimes posited as inherent in the physical makeup of a building, as when architectural historians judge a Venetian church to be an “unpromising” acoustic space” because its walls reflect an extreme amount of sound, garbling the singing. Others take acoustic space to be a figment of the human perceptual apparatus, a mental map of one’s surroundings constructed on the basis of what one hears, as when a writer describes how he gradually became attuned to “acoustic space” after going blind, or when a media scholar argues that nineteenth-century sound technologies prompted “a reconstruction of the shape of acoustic space.” For still others, acoustic space is better understood as a kind of social infrastructure, a collective framework for interacting with other members of a group through the making and hearing of sound: this is the intended meaning when an ethnomusicologist writes that the medium of radio provides its dispersed audience with a “shared acoustic space.”<sup>1</sup>

While the term thus lacks a single definition, most accounts of acoustic space assume some or all of the following characteristics: It is the primal, fluid milieu of oral communication and can therefore be only imperfectly congealed in images, written texts, and printed books. In human perception, it is the principal counterpart to optical space, with which it is customarily expected—but occasionally fails—to correspond. It is diffuse and immersive, and as a result it possesses mysterious and enchanting powers. It dissolves strict boundaries between the senses and is therefore at work in experiences of synesthesia and in fusions of the arts. Finally, it connects people in ways that are becoming ever more important with the ongoing expansion of electronic communication.

Such are the assumptions often linked with acoustic space. Yet these premises are contingent cultural ideas, not universally valid truths. Spatial concepts do not spring into being independent of spatial practices, and it would be a mistake to reify acoustic space as though it had some natural or self-evident existence independent of

the contexts in which sound is actually heard. The chapters that follow trace how inherited beliefs about acoustic space were influenced by the emergence of architectural techniques for controlling sound. The most important of these techniques were a set of complex—if never fully stable and reliable—geometric procedures for organizing the propagation of sound to large groups of listeners. European architects’ development of these methods, beginning in the early modern period and peaking around 1960, entailed creative inquiry into the three-dimensional behavior of sound and careful study of the subjective auditory impressions buildings could create.

This is not to suggest that earlier societies were oblivious to architecture’s sonic potential. Many premodern structures are renowned for extraordinary acoustic properties, such as the Pyramid of Kukulcán at Chichén Itzá, where the echo of clapping hands sounds like the call of the sacred quetzal bird. Remarkable as this effect is, however, according to most archaeologists it could not have been deliberately planned. Marcus Vitruvius Pollio did attempt to document acoustic design principles in the first century BC, possibly informed by earlier and subsequently lost Greek texts. While Vitruvius’s treatise has been studied by Western architects for millennia, though, his sections on sound are filled with arcane instructions of little use to subsequent generations of builders or theorists.<sup>2</sup>

What was new in the seventeenth century was a sustained effort to codify acoustic knowledge as a body of architectural thought. Natural philosophers posited that “echoes” traveled in linear rays, bouncing off the surfaces they encountered like light from a mirror. Even though, nearly from the outset, there were credible doubts about the reliability of geometry for describing the spatial propagation of sound, it at least offered a putatively objective way to plot sound’s movement graphically and thus to develop consistent, testable acoustic methods. Architects took note of these new geometric techniques and gradually elaborated them into practical design procedures. Acoustic methods were applied to the design of churches, theaters, and opera houses, among other building types. These structures’ evolving forms and uses made hearing a central concern, leading architects to debate how their walls, ceilings, and other components might be reshaped to project sound better, improve its clarity, or create exceptional effects such as an impression of enveloping reverberation.<sup>3</sup>

Geometric acoustics began declining in the 1890s, due especially to the work of American physicist Wallace Clement Sabine, who served as a consultant on architectural projects. The formula he devised to predict reverberation time—how long sound remains audible

before fully fading away—took a room’s overall size into account but not its specific shape. This quantitative approach made intricate geometric analyses of sound propagation seem unnecessary. The spatial conditions of listening were transformed even more radically by the rise of loudspeakers, radio, and other electroacoustic media, which could dissociate sounds from their customary surroundings and propagate them in ways that resisted geometric analysis and, in many cases, did not depend on architectural mediation at all. Since the mid-twentieth century, while architects have continued to draw simple geometric diagrams for quick approximations, they have relied on specialist consultants to perform precise calculations using computational methods, as well as on electronic sound systems to amplify and manipulate sound in more powerful ways than buildings alone ever could.

### The Idea of Acoustic Space

It was only at the end of this historical arc that “acoustic space” entered the general lexicon. Today, if this expression is to be usefully applied in the study of architecture, its semantic history deserves close examination. The term itself dates to the late nineteenth century, when physicists coined it to refer to the complex wave motion of airborne sound. Soon thereafter, experimental psychologists adopted it to describe how listeners attribute directionality and distance to auditory perceptions (see fig. I.1).<sup>4</sup> Then, in the 1920s and 1930s, the expression *akustischer Raum* began to appear in German writing about radio, both because this medium gathered together a dispersed public and thereby seemed to establish new spatial relationships among distant listeners and also because, within a broadcast, any desired indications of a physical setting had to be achieved by means of simulated acoustic effects.<sup>5</sup> Despite its sporadic usage in these three contexts, however, “acoustic space” remained a niche concept.

Suddenly, around 1960, it began to proliferate much more widely, increasing in frequency in English-language publications almost tenfold by the year 2000.<sup>6</sup> The turning point was the writing of Marshall McLuhan, the Canadian literary scholar turned celebrity philosopher of communication. McLuhan’s fundamental argument was that communication technologies mesh to form a complete perceptual environment and gradually reshape their users’ sensory faculties.<sup>7</sup> When he encountered the phrase “acoustic space,” he quickly seized on it. In an article for *Canadian Architect*, for example, he advised that the

ascendancy of acoustic space would have momentous consequences for the design of buildings and cities. To provide a parable for this shift, he pointed to an everyday domestic example: “The very concept of privacy, which originated with print culture in the 16th century, can no longer be sustained by the traditional means of partitioning space. The teenager has solved the problem as best he can by using radio to create an auditory private space for his homework.”<sup>8</sup>

In popularizing the idea of acoustic space, McLuhan packaged together the three principal senses it had already acquired: the spatial movement of sound, humans’ auditory perception of space, and the social characteristics of electronic media. Acoustic space soon became a mantra in McLuhan’s writings. He cast it as a harbinger of wide-ranging social transformations, including a general decline of linear thinking and specialization, a growing demand for participatory media, and a rise in political tribalism. He was especially struck by the term’s defiance of conventional perceptual categories. “The essential feature of sound,” he wrote with anthropologist Edmund Carpenter, “is . . . that it *be*, that it fill space. We say ‘the night shall be filled with music,’ just as the air is filled with fragrance.”<sup>9</sup> This account flew in the face of centuries of Western philosophy, which had long identified sound’s “essential feature” as its temporal organization. Nonetheless, McLuhan made no effort to offer a precise, consistent definition of acoustic space. On the contrary, he celebrated the term’s multivalence because—as will become clear—its built-in ambiguities seemed to bolster his particular account of European cultural history.

His explanation of its relation to architecture, in particular, was full of contradictions. On the one hand, he insisted that architects urgently needed to prick up their ears. He argued that modern architectural discourse was too visually oriented and that designers were wrongly ignoring the lessons of acoustic space. On the other hand, his thinking was actually profoundly indebted to architectural ideas, mostly by way of his friendship with the historian Sigfried Giedion (fig. I.2). “*Space, Time and Architecture* was one of the great events of my lifetime,” McLuhan later recalled, referring to Giedion’s wide-ranging 1941 study of modern architecture and urban planning.<sup>10</sup> McLuhan credited the book for showing him how to generalize from specific cases to produce sweeping, synthetic theories, as well as how to shape a historical argument that was as much a critique of the contemporary world as an account of the past. Likewise, McLuhan’s argument that media form an “environment” reflected the arguments of Giedion’s 1948 tome *Mechanization Takes Command*,

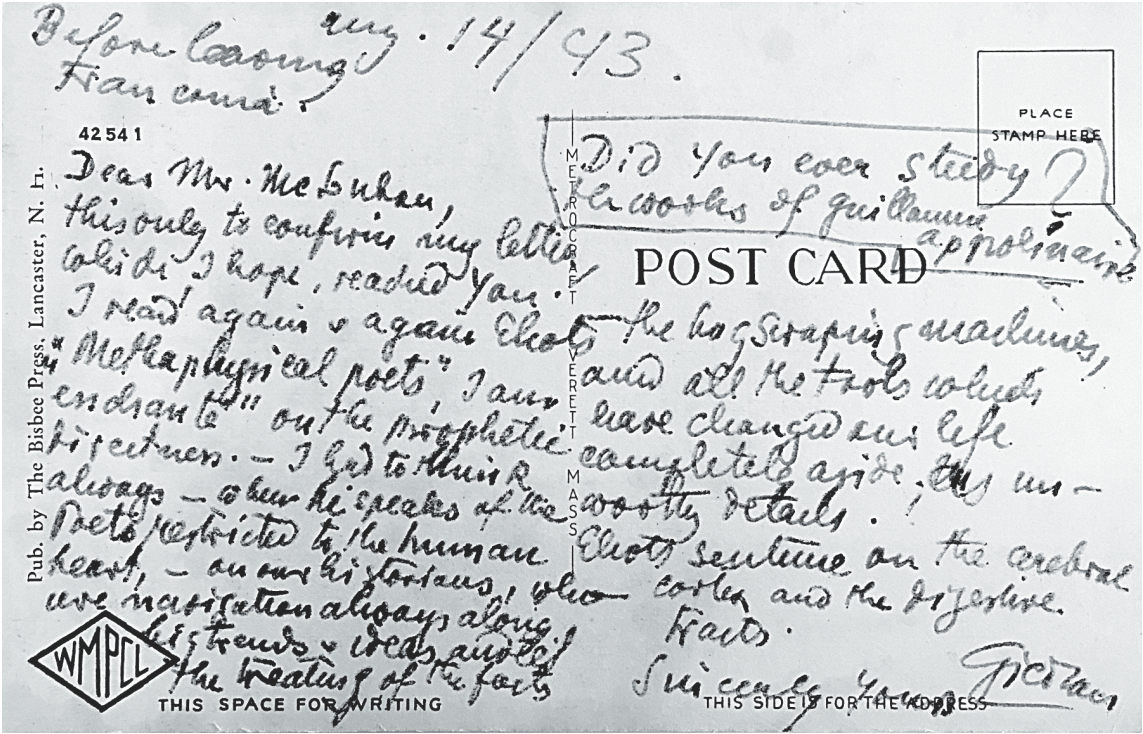


I.2. Postcard from Sigfried Giedion to Marshall McLuhan, August 14, 1943. In a note penned while on retreat in the pseudo-alpine environment of New Hampshire's White Mountains, Giedion thanks McLuhan for recommending T. S. Eliot's essay "The Metaphysical Poets." Given Eliot's interest in auditory playfulness, Giedion's choice of a view of Echo Lake—a site known for acoustic properties—was probably intentional. Library and Archives Canada, Estate of Sigfried Giedion.

which claimed that communication technologies had effectively reconfigured the human senses. "For the eye and the ear, doors to the emotions, media of mechanical reproduction were invented," Giedion wrote. Radio made possible "the

reproduction of sound through space . . . influencing every aspect of life."<sup>11</sup> As Larry Busbea explains, McLuhan was drawn to Giedion's scholarship because it seemed to offer "a method of describing a more visceral experience" of media than midcentury literary studies.<sup>12</sup>

Giedion's work, in turn, was predicated on European architects' preoccupation with *space* as a subjectively constructed category. The roots of this preoccupation lay in the late seventeenth century, when idealist philosophers posited that space was not a neutral container already given in nature but a mental category pieced together by each individual. This premise was gradually assimilated by architectural



discourse, reaching the height of its influence at the end of the nineteenth century, when historian August Schmarsow theorized architectural space as a formalist abstraction, and the beginning of the twentieth, when many designers took up the shaping of perceptual space as a paramount architectural goal.<sup>13</sup> Although these modernists posited space almost entirely in terms of vision (and occasionally of touch), the evolution of space as an architectural *idée fixe* invited broad speculation about the interplay of the senses in the subjective experience of the built environment.

These architectural influences were very much in play when McLuhan's idea of acoustic space took shape. It happened in the interdisciplinary University of Toronto graduate seminar "Culture and Communications," which he co-taught with Carpenter, urban planner Jaqueline Tyrwhitt (who had been active in the Congrès Internationaux d'Architecture Moderne or CIAM, the twentieth-century architects' guild that promoted functionalist design), psychologist David Carlton Williams, and economist William Thomas Easterbrook. In a series of seminar meetings in late 1954, the participants sorted through contributions for an issue of their journal *Explorations*

focusing on the theme of space, an idea that originated in their discussion of Giedion's work. McLuhan summarized a contribution by his former student Walter Ong arguing that the printing press had prompted an epistemic shift from auditory to visual ways of thinking. Carpenter outlined a prospective article on Inuit techniques of way-finding through listening. Tyrwhitt talked about Giedion's argument that premodern and non-Western architecture reflected alternative models of spatial awareness. Williams presented "Auditory Space," a phenomenological essay on spatial hearing that drew especially on the experiences of the blind. The last contribution in particular sparked a discussion on the perceptual, social, linguistic, and architectural implications of spatial awareness through hearing.<sup>14</sup>

McLuhan tended to dismiss any potential contradictions among his colleagues' disciplinary perspectives. His editorial hand was apparent when Williams's paper was published in *Explorations* with an expanded discussion of intellectual history and with the title "Acoustic Space," which McLuhan considered more evocative than Williams's original designation. The journal's 1960 anthology *Explorations in Communication* included a further revised version of the essay, now credited to Carpenter and McLuhan.<sup>15</sup> In its final iteration, the article adumbrated the account of human history that McLuhan went on to develop in more detail in *The Gutenberg Galaxy* (1962) and *Understanding Media* (1964). It claimed that the spatial consciousness of cultures outside the sphere of Western modernity had been deeply shaped by practices of oral communication (the article used the figure of "the Eskimo" to stand for "preliterate man" in general). Auditory ways of thinking and interacting declined in the West, McLuhan explained, following the Greeks' development of literacy. He later summed up his historical thesis about the civilizing power of writing: "From that magical resonating world of simultaneous relations that is the oral and acoustic space there is only one route to the freedom and independence of detribalized man. That route is via the phonetic alphabet."<sup>16</sup> With the expansion of radio and other electronic media, however (so went the argument), a long-dormant auditory sensibility was becoming relevant again. New communication technologies were causing the values of visual space—critical distance, distinct points of view, and separation or compartmentalization of the senses—to wane and those of acoustic space—immersion, sympathetic involvement, and multisensory or even synesthetic experience—to become dominant. Thanks to electroacoustic media in particular, Western society lived once again "in a single constricted space resonant with tribal drums."<sup>17</sup>



The work of McLuhan and his associates transformed theoretical exploration of sound and space. Previously, the mere fact that sound occupied space had largely slipped through the net of cultural history. Well into the twentieth century, the humanities tended to consider sound only through particular idealized cases such as music and the voice. McLuhan's writing and interdisciplinary dialogue were crucial for placing the spatiality of sound on the agenda of cultural inquiry.<sup>18</sup> His account still perpetuated a simplistic binary of sight and hearing, however. While he positioned himself as a champion of the latter, he maintained that Western societies had effectively dwelt in visual space since the fifteenth century, if not longer. Then, acoustic space had irrupted into the contemporary world with almost no warning as a result of new communication technologies. McLuhan's casual conflation of nonphonetic cultures from various parts of the world—from precontact North America to Africa to China—suggests that he conceived them only as foils for Western civilization and was not interested in engaging them on their own terms. Moreover, his insistence on the absolute alterity of auditory and visual sensibilities left little possibility of studying the cultural framing and technical mediation of hearing *within* modern history.

This tendency to exoticize sound explains why McLuhan had nothing to say about *modern* advances in the architectural manipulation of sound. Because he was committed to the premise that Western modernity had long been trapped in a visual straitjacket, he took no heed of European architects' extensive experimentation with acoustics in the immediately preceding centuries. The irony is that McLuhan's own thinking on the acoustic environment was powerfully shaped by European architectural discourse through the influence of Giedion and Tyrwhitt.

## Histories of Sound and Space

Historians of modern architecture by and large followed McLuhan's lead. Giedion, who visited the "Culture and Communications" seminar as a guest speaker in 1955, quoted from the "Acoustic Space" essay in his 1962 book *The Beginnings of Art* to describe the character of ancient ritual sites in caverns. In so doing, he relegated acoustic space to the architecture of prehistory. He went on to claim that it had been given new relevance in the work of Le Corbusier but he followed McLuhan in presenting its reappearance more as a spontaneous epiphany than an object of critical historical inquiry.<sup>19</sup>

Cultural discussion of sound and space was generally limited, in anglophone scholarship, to two experientialist frameworks, both informed by the McLuhan-Giedion model of acoustic space. The first, architectural phenomenology, took shape as a reaction against the modernist enthusiasm for industrial technology and drew quite loosely on phenomenological philosophy. In the woolly rhetoric of this movement, sound often played a special role. It was a catalyst for the spiritual power of *genius loci*, which was positioned as an urgently needed corrective to high modernist architectural ideas of space. The latter were “too abstract, being based on ‘functional’ or perhaps ‘visual’ considerations,” according to Giedion’s student Christian Norberg-Schulz.<sup>20</sup>

The other framework was composer R. Murray Schafer’s idea of “soundscape.” Schafer developed this concept at Simon Fraser University and elaborated it in his book *The Tuning of the World* (1977). His ecological view of the relation between places and their characteristic sounds was aligned in spirit with the architectural preservation movement gaining force at the same time. Schafer decried the modern proliferation of “lo-fi” sounds, particularly from noisy machines, whose broad-band acoustic output tended to mask the more delicately articulated sounds of the natural world. His writing and advocacy were tinged with nostalgia for a preindustrial era, but—influenced by McLuhan’s enthusiasm for sonic media—he and his associates used audio cassettes to record soundscapes they believed were endangered.<sup>21</sup>

Like McLuhan’s writing on the senses, the accounts of architectural phenomenology and soundscape studies built on polemical oppositions between vision and hearing. The dualistic contrast between these two senses was often framed in physical or physiological terms, which, as Jonathan Sterne points out, left little room for the possibility of historical changes in the sense of hearing.<sup>22</sup> Even as historians of art and architecture studied transformations over time and across cultures in how people see (“vision itself has its history,” as Heinrich Wölfflin declared in 1915), acoustic perception tended to be presented as historically invariable.<sup>23</sup>

This state of affairs started to change in the 1980s through a convergence of events in several fields. Following the widespread adoption of Dolby and THX high-fidelity stereo and multichannel sound technology in movie theaters, cinema scholars such as Rick Altman and Michel Chion wrote innovative histories of film soundtracks and how they were engineered to seem congruous with the settings shown onscreen. Musicians in the “historically informed performance”

movement and scholars of the “new musicology” began to study the architectural environments for which works had been composed. Historians and anthropologists of the senses, such as Alain Corbin, David Howes, and Constance Classen, investigated the sociocultural frameworks in which hearing is enmeshed, building on the work of Lucien Febvre and the *Annales* historians. In parallel with these scholarly developments, certain kinds of artistic experimentation with sound formerly identified as avant-garde music were gradually recategorized as “sound art” and exhibited in galleries. All of these shifts were informed by McLuhan’s idea of acoustic space, but they also implicitly or explicitly challenged his sensory abstractions and historical generalizations.

More recently, Sterne has launched a frontal assault on McLuhan’s history, pointing to a range of nineteenth-century auditory practices that laid the foundation for later innovations in sound technology. Barry Blesser and Linda-Ruth Salter have proposed a concept of “auditory spatial awareness,” which they have explored in various architectural contexts through an interdisciplinary framework. Emily Thompson has argued that Wallace Sabine’s equation-based acoustic methods helped define a distinctively American regime of “modern sound,” which she has examined in relation to electroacoustic technology, musical modernism, and the politics of noise abatement.<sup>24</sup> Building on all this scholarship, architectural historians, too, have started to undertake rigorous research into the acoustics of various buildings.

*Echo’s Chambers* adds to this increasingly rich discourse on sound and the physical environment. What is new here is the attempt to gain critical purchase over acoustic space by uncovering the concept’s historical roots in architectural design and theory. The present study argues that long before the 1950s, architects were working at the intersection of the physical, psychological, and media-theoretical lines of research that McLuhan eventually braided together in his concept of acoustic space (at the very moment, ironically, when geometric acoustic methods were on the decline).

## Method and Outline

The evidence examined in this book includes not only built structures but also written texts and drawings, which are no less important documents of architectural thought. The extent to which the modern production of buildings has relied on graphic media might seem like a considerable impediment to architects’ serious consideration of

acoustics. Yet the challenge of representing the sound of architecture on paper is just an especially acute case of a more general architectural difficulty. Robin Evans has noted the apparent “disadvantage under which architects labor, never working directly with the object of their thought, always working at it through some intervening medium, almost always the drawing.” His observation about designers’ “displacement of effort and indirectness of access” with respect to their work’s ultimate object—the building itself—holds doubly true for the issue of acoustics, which, in the cases explored here, was always engaged through visual analogies and visual media.<sup>25</sup> Evans goes on to argue, though, that far from being a hindrance, drawing has often had a powerful generative impact in architecture through its creative interplay with the designer’s three-dimensional imagination, resulting in the projection of built forms that could not have been achieved otherwise. By the same token, as each of the following chapters explores, architects’ struggle to *envision* sound and to represent it graphically was frequently a source of added complexity and conceptual richness.

The history of acoustic science plays only a limited role in this book. Notwithstanding architects’ professed desire to ground their work on empirical principles—as expressed in Carl Gotthard Langhans’s dictum in 1800 that to design a good theater “one must be not only an architect but a physicist, too”—this hoped-for synthesis of architecture and science never really came to pass.<sup>26</sup> Before Sabine in the 1890s, the most important professional scientists who studied the physical behavior of sound, such as Ernst Chladni and Hermann von Helmholtz, devoted only a very small proportion of their writing to the practical application of acoustics in the built environment. Their work rarely made a strong impression on architects, who preferred to cultivate acoustic methods of their own. Thus, in 1871 Charles Garnier could still observe that architectural acoustics fell far short of being a “positive science.”<sup>27</sup>

After Sabine finally did claim it as a problem for scientifically trained engineers, he cited Garnier’s remark approvingly and dismissed architects’ earlier research.<sup>28</sup> Yet while Sabine was undoubtedly a central figure in the restructuring of acoustic expertise that took place during this period, he and his advocates have tended to overstate the larger implications of his research. In Thompson’s account, when engineers took responsibility for shaping sound, acoustics became thoroughly disenchanting, a matter for empirical measurement, calculation, and remediation. She writes that, through Sabine’s work and that of his contemporaries, “the age-old connection between sound and space—a connection as old as architecture itself—was severed.”<sup>29</sup>

This was, however, hardly the first time buildings had been designed with the intention of mediating sound and producing artificial acoustic effects. It was only Sabine's positivism that brought about a historical deafness to this fact and birthed the fiction of an "age-old" time before modern energy science, when sound and architecture had an ostensibly natural, transparent connection.

Unlike Sabine, this book takes architects' myths and misconceptions as seriously as it does their empirically validated discoveries. After all, as Manfredo Tafuri points out, unrealized proposals and failed works are often the most telltale indicators of hidden conceptual fault lines.<sup>30</sup> Architectural theories of sound have included a number of erroneous beliefs, such as the eighteenth-century notion that a theater's acoustic efficacy was largely determined by the particular curvature of its floor plan, as well as the long-standing assumption—still repeated by some contemporary designers—that a building can or should be designed to vibrate like the soundbox of a musical instrument.<sup>31</sup> Such beliefs might not figure prominently in a history of acoustic science or technology, but they have loomed large in architectural theory. Taking errors and unresolved problems seriously is consistent with the premise that architecture's cultural significance lies not merely in how it solves practical challenges but, more importantly, in how it gives form to social and conceptual tensions.

As far as the present study is concerned, many of these tensions relate to the emergence and expansion of what might be called a "listening public." The period examined here was marked by a flourishing of theater, instrumental music, and opera, as well as new forms of political discourse and significant transformations in religious belief and practice. Jürgen Habermas's well-known history of the modern public sphere emphasizes the burgeoning of print media, but in fact buildings played a crucial role. As Richard Wittman observes, even as citizens came to think of themselves as members of a dispersed public constituted by the circulation of books and periodicals, architecture was increasingly expected to compensate by facilitating the assembly of collectives in space. This imperative raised the stakes for acoustics. Not only was the new public sphere frequently likened to an immense auditorium, as Kate Lacey points out, but bricks-and-mortar auditoria were also crucial settings where citizens cultivated listening skills that helped make the liberal social order possible. In the process, the acoustic properties of buildings came to be debated not just by elite thinkers but also by a much wider public.<sup>32</sup>

With these principles in mind, the following five chapters examine five historically linked episodes in the development of geometric

acoustics. They revolve around instances when acoustics was posited as a core architectural concern—that is, one essential to a building’s social purpose and artistic meaning, rather than simply a mundane functional criterion. The chapters fit together in a more or less continuous narrative but can also be read as independent essays.

The first three discuss the rise of geometric methods for sound control and the critical reactions they elicited, each chapter focusing on the most advanced and influential acoustic theories proposed in a particular era. Chapter 1 examines the geometric studies of echo undertaken by seventeenth-century natural philosophers—most notably Athanasius Kircher, who proposed a highly imaginative array of sonic devices and effects based on the reflection of sound. Since the rise of sound studies and sound art in the 1970s and 1980s, Kircher’s illustrations have been frequently reproduced, though generally with little discussion of his intentions or how his thinking was influenced by the massive construction site that was early modern Rome. The chapter puts Kircher’s work in context and argues that his study of the distinctive auditory properties of echo was not only informed by his own architectural environment but was also in tension with the visual medium of print he used to make his case. His “echotectonic” research evinced a more complex interlacing of vision and audition than is reflected in McLuhan’s dualistic analysis of the senses.

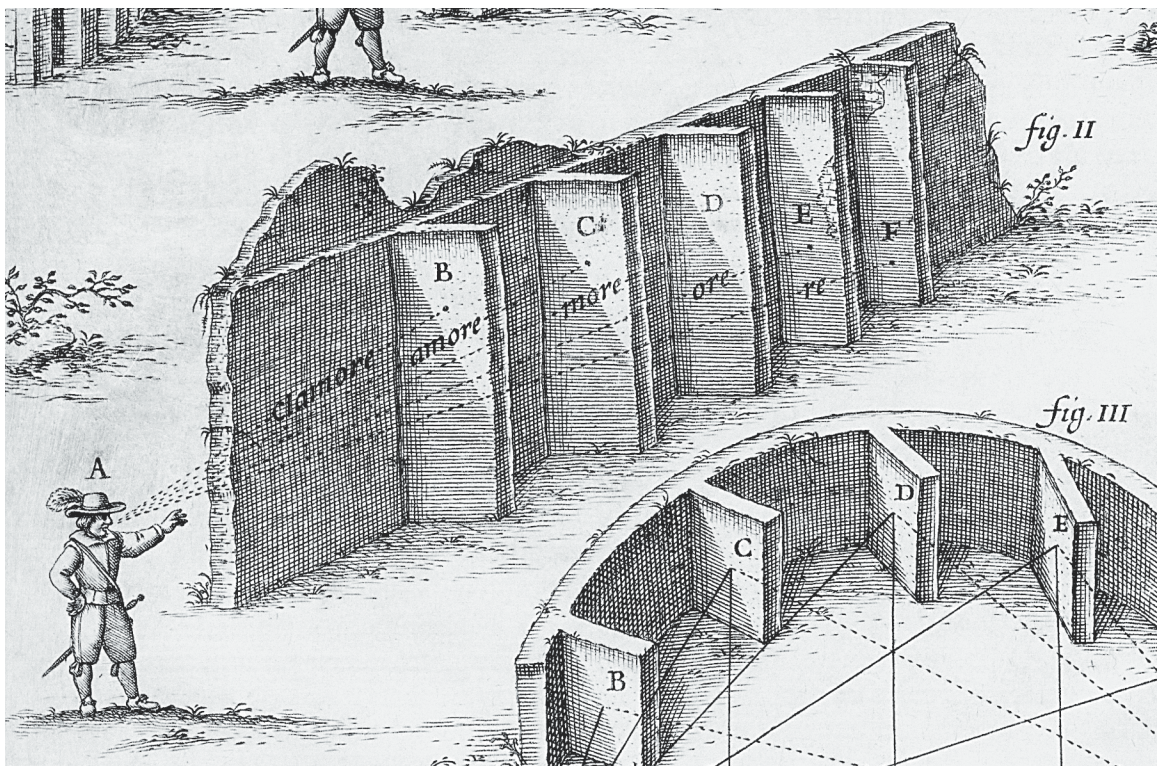
Chapter 2 explores how graphic techniques for acoustic design were adopted and adapted by French Enlightenment architects. This period has often been credited with the construction of modern regimes of visibility, but its acoustic advances have received far less attention. In particular, the chapter examines Pierre Patte’s advocacy for redesigning public theaters according to empiricist principles. His goal of assuring a naturalistic correspondence between the audience’s visual and auditory experience of dramatic space raised serious questions about whether acoustics could ever really be managed through geometric reasoning.

Chapter 3 focuses on the Berlin architect Carl Ferdinand Langhans, who championed reverberation as an immersive effect. His design method explicitly challenged earlier graphic conventions associated with acoustics, appealing ultimately to architects’ spatial imagination to plan for the uniform diffusion of sound. Instead of confining his “catacoustic” theory to the narrow technical frame in which the architecture of this period is sometimes discussed, the chapter situates Langhans in the development of German Romanticism and shows how his acoustic work was linked with a larger conception of architecture as the systematic design of experience.

In the second half of the nineteenth century and the first half of the twentieth, architects' acoustic methods multiplied rapidly. Rather than attempt a comprehensive account of the many developments during this period, chapters 4 and 5 examine two key figures of modern culture whose efforts to build for sound threw these developments into especially sharp relief. Chapter 4 is an interdisciplinary study of acoustics in composer Richard Wagner's idea of the *Gesamtkunstwerk* or "total work of art." His purpose-built theater in Bayreuth, Germany, is widely acknowledged by scholars of music and media as an essential site of cultural modernity, but it has been neglected in the history of architecture. Its little-known designer, Otto Brückwald, was in fact an acoustic specialist, and the chapter argues that reverberation—as simulated in Wagner's orchestrations, described in his dramatic texts, and actually produced in Brückwald's theater—was central to the composer's project of artistic and sensory synthesis.

Finally, chapter 5 considers how Le Corbusier responded to the rise of electronic amplification and broadcasting by seeking to reconcile the dislocating tendencies of new sound technologies with modernist architectural ideas of form and space. His early fascination with auditory modernity led him to embrace geometric acoustics. In the 1950s, when this approach was facing obsolescence, he reinterpreted it in a totally unexpected way, as an avenue for speculating about the vocation of architecture in the age of mass media. The chapter offers a new reading of his chapel of Notre Dame du Haut in Ronchamp, France, as a project about communication and community in the post-war era. It shows a leading modernist architect not only well aware of new sound technologies but also using the medium of architecture to reflect broadly on their sociocultural implications.

Each of these chapters incorporates thematic threads that tie into contemporary discourse. The intention is not to collapse the intervening historical distance and treat the past as though it were the present, but rather to show how certain contemporary ideas too often treated as transhistorical constants are in fact part of a still-evolving discourse. What emerges from this investigation is that, to the extent the phrase "acoustic space" signifies anything at all, its meaning is entangled with the techniques, ideals, and persistent myths of modern architecture.



1.1. Athanasius Kircher, illustration of echo poetry, from *Musurgia Universalis* (1650). Universitätsbibliothek Basel.