for a comparable period of time. More than this, sounds may alter or disappear with scarcely a comment even from the most sensitive of historians. [...]

R. Murray Schafer, extract from *The Soundscape: Our Sonic Environment and the Tuning of the World* (New York: Alfred Knopf, Inc., 1977); revised edition (Rochester, Vermont: Destiny Books, 1993) 3–4; 7–8.

Alvin Lucier
Careful Listening is More Important than Making Sounds Happen//c. 1979

The Propagation of Sound in Space

For several hundred years Western music has been based on composition and performance. Most attention has been focused on the conception and generation of sound, very little on its propagation. Written notes are two-dimensional symbols of a three-dimensional phenomenon. No matter how complex a system of notation or how real the illusion of depth, written music is trapped on a flat plane. Even musics from oral traditions are rooted in performance rotes and instrumental topologies or rely on texts, stories or social hierarchies. We have been so concerned with language that we have forgotten how sound flows through space and occupies it.

Sounds have specific spatial characteristics. Those of short wave length (high frequencies) are directional; longer ones (lows) spread out. Sound waves flow away from their sources roughly in three dimensional concentric spheres, the nodes and antinodes of which, under certain circumstances, can be perceived in a room as clearly as those of a vibrating string on a violin. Each space, furthermore, has its own personality that tends to modify, position and move sounds by means of absorptions, reflections, attenuations and other structurally related phenomena. Conventional acoustic engineering practice has historically defied these phenomena in an attempt to deliver the same product to everybody in the same space. Accepted as natural occurrences to be enjoyed and used, however, they open up a whole new field of musical composition. For the past several years I have conceived a series of works that explore the natural properties of sound and the acoustic characteristics of architectural spaces as musical objectives.

I was not composing music in 1965 and had lost confidence in the musics of my education. Post-Webern serialism, particularly as I had witnessed it earlier in Darmstadt, seemed florid and complex enough to be obsolete, and the tape music of that period seemed to be only an extension of that language. I felt the need for a new idea. When the physicist Edmond Dewan offered his brain wave equipment with which to explore the possibility of making music, I had a ready and open mind. As I started learning to generate alpha to make sound, I began experiencing a sensibility to sound and its production different from that of other musics based on ideas of tension, contrast, conflict and other notions of drama. To release alpha, one has to attain a quasi-meditative state while at the same time monitoring its flow. One has to give up control to get it. In making *Music for Solo Performer* (1965), I had to learn to give up performing to make the performance happen. By allowing alpha to flow naturally from mind to space without intermediate processing, it was possible to create a music without compositional manipulation or purposeful performance.

In the spring of 1968, with Pauline Oliveros, I began picking up images for a new work. The ocean suggested sea shells, and a nearby canyon offered itself as a large resonant environment in which they could be sounded. I designed a performance of a new work, *Chambers*, in which several shell players, starting from a small circle, spread out through the La Jolla landscape, describing the outdoor space in terms of their sounding shells. Later I expanded the idea to include any small or large resonant chambers that could be made to sound. I thought of them as rooms within rooms which impinge their acoustic characteristics upon each other.

I then made several works that articulated spaces in more specific ways. *Vespers* (1968), based on the principle of echolocation [the use of sound to locate objects or navigate], uses pulsed sounds, such as those used in acoustic testing to make acoustic signatures of enclosed spaces. As reverberation times are measured, the quality of the surrounding environment is described by comparing the timbre of the outgoing pulses with those that return as echoes. Time and space are directly related; durations are proportional to distances between sound sources and reflective surfaces. In *I am sitting in a room* (1970), several paragraphs of human speech are used to expose sets of resonant frequencies implied by the architectural dimensions of various sized rooms. By means of a pair of tape recorders, the sound materials are recycled through a room to amplify by repetition those frequencies common to both the original recording and those implied by the room. As the repetitive process continues and segments accumulate, the resonant frequencies are reinforced, the others gradually eliminated. The space acts as a filter. We discover that each room has its own set of resonant frequencies in the same way that musical sounds have overtones. And in *Quasimodo the Great Lover* (1970) sounds sent over very long distances, by means of relays of microphone-amplifier-loudspeaker systems if necessary, capture and carry the acoustic characteristics of the spaces through which they travel. Total distance is determined by the amount of space necessary to modify the original material to a point of unrecognizability.

Recent works have been more concerned with the properties of sound itself than with how it acts in space. *Still and Moving Lines of Silence in Families of Hyperbolas* (1973–74) is an exploration of standing waves and related phenomena. If a pure wave emanated from two sources, or one source and a reflective wall, standing waves will form in symmetrical hyperbolic curves equidistant and either side of an imaginary axis between the sources. If two closely tuned waves emanate from two different sources, beating patterns will cause the crests and troughs of sound to spin in elliptical patterns toward the lower-frequency source. Changes in intonation will cause changes in speed of beating and, if unison nulls are crossed, direction of movement. In this work, dancers search for and move in troughs of audible beats which move out to listeners as ripples on a pond, and players of electronic and acoustic instruments spin crests of sound in polyrhythmic figures through space.

In *Outlines of Persons and Things* (1975), sound waves are used to create diffractive patterns around opaque objects, producing silhouettes which may be perceived directly with one's ears, or loudspeakers which shift, enlarge and amplify the images. If either the object or the listener moves, slight phase changes will cause perceptible variations in the resulting fields. If the illuminating sounds consist of two or more closely tuned frequencies, temporary speed-ups and slowdowns of the rhythmic patterns will occur.

Often it is necessary to provide visual clues as to the overall sound situation. You may be sitting in the trough of a standing wave or on the edge of a sound shadow, but since you cannot be everywhere at once, you hear only what is available to your location in space. Your focus is oblique. In *Directions of Sounds from the Bridge* (1978), for example, sound-sensitive lights are stationed around an oscillator-driven cello to sample the changing volume shapes caused by the directional characteristics of the instrument. Stringed instruments cast sound shadows around themselves in shapes determined by their resonant characteristics. In small spaces or in situations where amplification is possible, the shapes that flow from the tops, bottoms and sides of instruments are apparent to listeners. And in *Bird and Person Dyning* (1975), a work in which phantom images seem to appear in various places in space because of the apparent locative properties of acoustic heterodyning [the generation of new frequencies by mixing two oscillating waveforms], a performer wearing miniature microphones in his/her ears, dips, turns and tilts his/her head, altering pitches of strands of feedback created between the microphones and pairs of loudspeakers. In this work as in several others, performing is more a matter of careful listening than of making sounds happen.

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WALLS, FLOORS AND CEILINGS COULD BE THOUGHT OF AS ACOUSTIC LENSES.

I often dream of performance spaces specially designed for works based on the three-dimensional characteristics of sound. Paraboloids, spheroids and other similarly shaped rooms with movable walls could be constructed to position, move and modulate sounds. Walls, floors and ceilings could be thought of as acoustic lenses whose focal points are determined by reflective time. It is also possible to create imaginary spaces by means of computer simulation. In *RMSIM 1* (1972), a digital computer drives a configuration of analogue modules into which is fed a live microphone placed in an enclosed space. Changing values of resonant filters, amplifiers and reverberation units suggest changes in the size and structure of simulated rooms. And in *Clocker* (1978) a galvanic skin-response detector controls the speed of a ticking clock at several separate time delays, creating reflected sound from appropriately positioned loudspeakers so as to suggest changes in size and shape of memory-triggered rooms. Given enough delay lines and loudspeakers, any real or imagined rooms may be simulated.

I am now working on a series of solar sound systems for public places. Solar panels of various types, sizes, configurations and energy collecting capabilities are deployed at onsite locations, facing various compass directions relative to apparent daily sunrise and sunset. As sunlight falls on the panels at different intensities at different times of the day and year in various weather conditions, varying amounts of voltage are collected which drive packages of electronic music modules, amplifiers and loudspeakers, creating a continually changing music. Nearby trees and shrubbery, corners of adjacent buildings, passing people and cars may cast shadows or absorb enough sunlight to bring about further changes in the music.

Each installation will be unique. The number and size of the panels will be determined by the complexity of the sound system and size of the installation. In most cases, the basic sound source will be a pulse wave, chosen for its low power consumption – for example, it may be on duty for only ten per cent of a given cycle. Filters will be used for timbre control. All systems, however, will be completely solar powered. The generation, propagation and quality of the music will be determined by the intensity of the sun's rays at any given moment in time.

Alvin Lucier, 'Careful listening is more important than making sounds happen: The propagation of sound in space' (*c.* 1979), in Lucier, *Reflections: Interviews, Scores, Writings* (Cologne: MusikTexte, 1995) 430–38.

Bernhard Leitner
Acoustic Space//1985

[...] Modern building technology and building economics have indeed shown almost total disregard for the fact that human beings need rooms with good, 'live' acoustic qualities. I am not talking about technical means of soundproofing and the like. Take the following solutions which are typical for our civilization: people are buried in rooms built out of concrete, and at the same time we are developing highly sophisticated stereo and quadrophonic hi fi technologies to allow some sounds to come alive in these spaces. In all the theory of modern architecture we find very little or nothing about the relationship of sound, space and body. The main concern has been, as we all know, to use architecture and town planning as a means of resolving social conflicts and problems. But even this effort was essentially dominated by the powerful hostility with which the Enlightenment regarded the human body. [...]

Bernhard Leitner, statement from 'Acoustic Space: A Conversation between Bernhard Leitner and Ulrich Conrads', *Daidalos*, no. 17 (Berlin, September 1985).

Emily Ann Thompson
Sound, Modernity and History//2002

[...] By identifying a soundscape as the primary subject of [*The Soundscape of Modernity*, 2002], 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