THE ROUTLEDGE COMPANION TO THE SOUND OF SPACE

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CHAPTER 17

ON VIBRATIONAL ARCHITECTURES

Gascia Ouzounian (text) and Jan St. Werner (images)

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ON VIBRATIONAL ARCHITECTURES

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Tremblings

In distinction to the spectacular forms that lined the exhibition grounds of the 13th Venice Biennale of Architecture in 2012, whose theme was 'Common Ground', the Polish Pavilion by Katarzyna Krakowiak was remarkable not in what it portrayed but in what it revealed and transmitted: the sounds and vibrations of the pavilion, its infrastructure, and its surroundings. Vibrations produced by the building were 'explored and amplified'[1]; the capacity of its infrastructure – such as its ventilation system – to funnel, filter, and transmit sound were reinforced; and the sounds and vibrations of neighbouring pavilions were made audible inside it, bringing the building into a resonant dialogue with its environment and thereby crafting through sound, as the biennale judges remarked when awarding the project an Special Mention, a genuine 'common ground'.[2]

When announcing the biennale's theme of 'common ground', the architect David Chipperfield stressed that it was intended to denote the role of architecture in 'defining the common ground of the city' while also evoking 'the ground between buildings, the spaces of the city'.[3] Krakowiak's acoustic reconfiguration of the Polish Pavilion, *Making the walls quake as if they were dilating with the secret knowledge of great powers* (2012), made clear that this common ground could be construed not only metaphorically, as in the shared social and political concerns articulated by architecture, or literally, as in the physical ground shared by buildings, but also in something as immaterial and elusive as the air. It made tangible the idea that buildings are connected through the energies they share, including the sounds and vibrations they produce, mediate, and transmit – vibrations that pass through the ground and through the air; and that buildings themselves have vibratory capacities that, in contrast to longstanding architectural traditions that have sought to diminish them, can be productively enhanced and reinforced.

A critic wrote of the Polish Pavilion that it 'collaborates with neighboring pavilions' by echoing them.[4] Indeed, one could say that the building both resonated with the sounds of other buildings, thus symbolically dissolving the separation between nations; and that it came into a fuller resonance with itself, its materiality and physicality gaining voice through technological, acoustic, and architectural interventions. According to curator Michał Libera, these interventions included reinforcing the pavilion's resonant frequencies and naturally long reverberation time (over six seconds) to the point that speech inside it became unintelligible; installing a temporary wall and

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a temporary floor and tilting both at slight angles, thereby increasing the reflective capacities of architectural surfaces; and dismantling an artificial ceiling that had been put in place for previous exhibitions, exposing a skylight and opening the pavilion to neighbouring sounds via ventilation pipes and holes. While most of these interventions resulted in increasing the building's reflective capacities, a passage near the entrance of the pavilion was soundproofed to diminish ambient sounds and thus 'prepare' visitors to experience an aural architecture.[5] A final gesture, Libera explained, was to present 'a "live sonification" of the vibrations of the walls of the entire building'. He wrote:

> The trembling of the walls is translated into sounds and made audible in the space of the pavilion, together with the trembling of selected parts of the building. A network of sensors and cables entwines the entire architectural complex, including the façades of the adjacent pavilions, marking the continuity of sound as a phenomenon.[6]

Thus, the pavilion's tremblings – subtle tremors and mechanical oscillations that would not normally produce audible sound – were converted into acoustical energy and amplified; as were the tremblings of adjacent buildings, whose vibrations were similarly made audible and sensible, transmitted via loudspeakers hidden behind the temporary wall and floor in the Polish Pavilion.[7] These 'live sonifications' of architectural tremblings revealed the vibratory nature of architecture, suggesting that a building is not an isolated entity but rather one that operates within a wider ecology of sensible energies. As such, the pavilion was a meditation on architecture as it might be rewritten in the language of vibration, with the transmission of acoustic and vibro-acoustic energies as an organising principle of architectural forms and spaces and a key dimension of architectural experience.

Although Krakowiak's pavilion was centrally concerned with the interrelationships of sound and architecture, the building was not imagined as a sound stage or a structure in which to install sounds. Such gestures have predominated in sound art traditions since the late 1950s, when Le Corbusier, Iannis Xenakis, and Edgard Varèse's pavilion for the 1958 Brussels World's Fair, *Poème électronique*, used a multichannel system to route sounds to hundreds of loudspeakers placed throughout the building, 'engulfing' listeners in what Varèse described as a 'spatial music'.[8] By contrast, the Polish Pavilion was conceived of as a sound-generating entity itself, one whose intrinsic sound-producing, sound-mediating, and sound-transmitting capacities were highlighted and extended. By making audible the tremblings of the building and those of adjacent buildings, the pavilion was reconfigured as a vibrational architecture: an architecture comprised not only of solid forms, fixed structures, and stable materialities, but also of trembling, vibrating, oscillating, quaking energies. By making sensible the vibratory dimension of architecture, the pavilion embodied the idea that architecture can serve not only to 'contain' or reflect acoustic energies, but also to produce, transmit, mediate, filter, combine, and recombine them. It engaged architecture as a dynamic, moving phenomenon, productive of and mediating energies that should be sensed and heard; and it revealed the interconnectedness of seemingly distinct architectures that were nevertheless intertwined in the common realm of vibration.

Vibrational architectures

In considering sound in relation to architecture, a predominating model in Western architectural and scientific thought since 1900 has been that of reverberant space: of architecture as a container for sound and acoustical reflections; and of architectural forms as having acoustical characteristics

that derive from their capacity to reflect and absorb sounds that occur inside them. Architects and acousticians routinely describe a room in terms of its reverberation time, the time it takes for sound inside the room to decay over a specific dynamic range (typically 60 dB). The modern scientific discipline of architectural acoustics, generally traced to the work of the American physicist Wallace Clement Sabine – whose equation for calculating the reverberation time of a room was instrumental in establishing acoustics as a scientific enterprise[9] – is rooted in this model of reverberant space, one in which architecture acts as a physical structure that absorbs and reflects sounds, but not necessarily one that produces or transmits sounds and vibratory phenomena, apart from unwanted noises and vibrations that should be reduced and attenuated.[10]

This essay explores the possibilities of a vibrational architecture and its potential to reorient architectural thought and practice. 'Vibrational architecture' here refers to architectures whose energetic capacities are highlighted (not reduced); and to architectural and spatial practices that privilege vibrational phenomena, including audible and inaudible sound. Vibrational architecture can be a way of conceptualising architecture as comprised not only of materialities, but also of energies that modulate and complicate those materialities. Vibrational architectures challenge the perceived fixity and stability of architectural forms and structures, including monumental architectures that are imagined as enduring and immutable. In engaging the possibilities of a vibrational architecture, this essay asks: how would the study of architecture change when architecture is considered not only or primarily in relation to solid, fixed, enduring, material forms but also in relation to energies that are emergent, transient, ephemeral, and unpredictable? How would architectural history change if it were to consider not only what was built and what remains, but also what passes through: those energies that have been produced, transmitted, reflected, and absorbed by architecture?

In engaging with the idea of vibrational architecture, this essay draws on the work of theorists and practitioners who work across sound, architecture, and vibration, notably Maryanne Amacher, Mark Bain, Steve Goodman, Katarzyna Krakowiak, Mendi + Keith Obadike, Jonathan Tyrrell, and Jan St. Werner, among others. In Sonic Warfare, Steve Goodman recalls a scene from the popular Japanese manga series *Patlabor* in which 'the vibrational architecture of the city becomes a weapon'.[11] Goodman suggests that this form of sonic warfare – one that arguably occurs not only in fiction but also in contemporary warfare in which the urban environment is weaponised to transmit harmful vibrations – that 'the city is no longer merely the site of warfare but, as a result of the resonant frequency of the built environment, the very medium of warfare itself. The plot', he remarks, 'tunes into the city as an instrument, not just venue, of terror'.[12]

Goodman is specifically concerned with the capacity of what he calls 'the vibrational architecture of the city' – its vibrational substrate – to be mobilised to participate in an ecology of terror, transmitting fear, dread, and other negatively valanced affect in 'climatic' and 'volatile' ways to a city's population through the spread of 'bad vibes'.[13] In this scheme, the built environment acts as a 'resonating surface' that, tuned to certain frequencies (Goodman is particularly interested in low frequencies and infrasound), transmits bad vibes to a populace, 'sending an immense collective shiver' through it.[14] Goodman's scenario taps into anxieties about the nefarious uses of an invisible medium (sound) by governments and militaries, anxieties that have circulated since early experiments on the effects of infrasound in the 1930s, and that typically map onto wider anxieties about unknown forces at play in the political arena.[15] It is especially salient here in imagining the city as a vibrational topos or network – an interconnected system or, as Goodman puts it, 'vibrational ecology' that can be activated, instrumentalised, and potentially weaponised through sound and vibration.[16]

An aesthetics of material transmission

In his anthropology of ocean science, which considers the underwater sounds that scientists interpret while submerged in submarine vessels, Stefan Helmreich proposes transduction – the conversion of energy from one energetic substrate to another – as an analytic, a frame through which to understand the flows of sound across physical boundaries and media.[17] Transduction, he suggests, can be helpful both in 'thinking about how space, presence and soundscapes are produced', since, for example, underwater sounds must be converted from one form of energy into another to be audible inside submarines; and as a way of 'theorizing against immersion'.[18] The concept of soundscape 'has become haunted by the notion of immersion', Helmreich argues, the idea that listeners are 'at once emplaced in space and, at times, porously continuous with it'.[19]

Indeed, the idea of immersion has haunted not only the notion of soundscape but also the domain of architectural acoustics, which principally considers acoustical environments as ones in which subjects are emplaced, with sounds and acoustical reflections taking place all around them. By contrast, in a vibrational architecture the listening subject is not immersed in sound so much as their body is coupled with acoustic and vibro-acoustic energy, mediating sound and vibration, 'connect[ing] the occupier to that which is occupied'.[20]

In *Architecture's Acoustic Shadow: Unsettling the Sound-Space Relationship*, the architect, artist, and theorist Jonathan Tyrrell suggests that 'an emphasis on reverberation has overlooked how sound operates transversally, moving through bodies and matter, undermining spatial division, and confounding architectural legibility'.[21] Tyrrell asks, 'How [would] a focus on material transmission rather than reverberation change the way space and sound are mutually conceived and experienced?'[22] Tyrrell's incisive question signals what, if adopted more widely, would entail a paradigmatic shift in architectural discourse and practice in relation to sound, as well as conceptions of sound space more broadly. It points to models that challenge the immersion framework articulated by Helmreich and embodied in works such as *Poème électronique*. If Varèse's concept of a spatial music was contingent upon the notion of sounds 'surrounding' and 'engulfing' listeners, and if sound art traditions that have developed from that model have privileged an aesthetics of sonic immersion, what are alternative models that focus on the material transmission of sounds – or, put another way, an aesthetics of material sound transmission – and what are their genealogies?

What Tyrell identifies as a missing focus on material transmission can be traced in the work of practitioners who have emphasised architecture's capacity to transmit and mediate sound and vibration. Tyrell himself points to the work of Maryanne Amacher and Mark Bain, who, he writes, 'have both worked with the direct vibration of architectural matter', drawing attention to Amacher's concept of '"structure-borne sound" (material propagation at high intensities)'.[23]

If Varèse's concept of a spatial music 'engulfing' listeners was foundational in articulating an aesthetics of immersion, Amacher's practice of working with structure-borne sounds can be considered equally foundational in articulating an aesthetics of material transmission. According to Amy Cimini and Bill Dietz, with *Living Sound, Patent Pending* (1980), her first architecturally scaled work, Amacher used both structure-borne and airborne sound transmission to transform the entirety of a vacant mansion in St. Paul, Minnesota, into a sonic architecture, raising 'a host of new technical questions and considerations (e.g., the necessity of idiosyncratic loudspeaker placements so as to transmit and filter sound via physical substrates such as walls)'.[24] In contrast to spatial sound works installed 'in' buildings, with *Living Sound, Patent Pending*, an entire building

was reconfigured as a resonating structure – a 'gigantic instrument' – that pulsated with acoustic energy. Amacher remarked:

> A visitor who stepped "off limits" into the kitchen was literally slammed up against the refrigerator by the force of the energy. Others felt themselves pushed, as if by acoustic pressure, out into the garden, where the entire house was heard, sounding, as a gigantic instrument.[25]

With *Living Sound, Patent Pending*, the coupling of sound to building materials magnified sound's physical force and seeming omnipresence. Elsewhere, Amacher spoke to the potential of structure-borne sounds to enhance the expressive potentials of music, saying of her process that:

> It's going to the space, finding these kinds of spots where the sound can sort of take on its life, traveling through the structure, one way or another. […] I never like to work with a lot of speakers, because I would prefer to get the sound alive in the architecture. I now believe that the architecture can make magnifying really expressive dimensions in music in a way that you can't do any other way.[26]

If Amacher sought to 'get sound alive in architecture', Mark Bain has arguably sought the inverse – getting architecture alive in sound. Such an impulse has shaped Bain's vibro-acoustic works which, since the late 1990s, have engaged the conductive and vibrational capacities of architectures and bodies. One of Bain's best-known projects in this vein is *The Live Room: Transducing Resonant Architecture* (1998), originally conceived for a room at Massachusetts Institute of Technology (MIT) that had large concrete isolation pads separated from the rest of the building's foundation to control for external vibrations. For this manifestation of *The Live Room*, Bain mounted 'acoustic-intensifying equipment' directly onto the foundational structures of the room, setting the architecture into vibration by sending intense impulsive energy through it, '[imparting] frequencies into the building, the floor and the persons who were situated in the room'.[27] More specifically, he mounted six rotary-type mechanical oscillators with a frequency range of 1–30 Hz directly onto the floor system, setting it into vibration apart from energetic 'dead spots' where the seven concrete isolation pads were located.[28] He made this vibrational 'topology' visible by placing fine sand on the floor system, revealing vibrational patterns and nodes much in the vein of Ernst Chladni's experiments with vibrating plates in the late 18th century.[29]

Bain's process in *The Live Room* entailed identifying the resonant frequencies of objects and structures; using a series of mechanical oscillators to vibrate and resonate them, and, setting into motion a network of vibrations, triggering vibrational 'feedback' processes that he likened to additive synthesis; and, through mechanically induced vibrations, additionally producing sympathetic vibrations in nearby bodies and objects. *The Live Room* thus operated as a 'vibrational ecology': a complex, dynamic vibrational system or network in which various vibrations reinforced, cancelled out, and produced other vibrations.

Bain conceived of *The Live Room* as a 'vibro-acoustic environment that engages directly the architecture, the room and the people who occupy it'.[30] He treated both the building and visitors' bodies as having specific resonant frequencies that might be excited through vibration, writing:

> Buildings too, along with bodies, have their own particular resonant frequencies. If you locate this frequency, and its associated value of efficient excitation, and through mechanical

> reinforcement impart this frequency, it is possible literally to "ring" a material in a manner similar to striking a bell. If, through a feedback system, a phase-aligned addition to this waveform is encouraged, it may become possible for the materials to oscillate out of control.[31]

With *The Live Room* Bain treated buildings, architectural materials, and bodies on equal terms, as objects that have the capacity to conduct vibro-acoustic energy. He noted that architectural materials, in contrast to a gas like air, typically have dense molecular structures and can therefore conduct acoustic energy relatively efficiently; and that not only bodies but also individual body parts – 'organs, bones, and tissue' – have specific resonant frequencies that can be excited through vibration.[32] Here, the listener did not only or primarily 'receive' sound through cochlear audition and interpret it through neurocognitive processes of listening. Instead, the listening subject was arguably reconfigured as an object – a thing that, like other things, participated in vibrational ecology, conducting, mediating, modifying, absorbing, and potentially producing sound and vibration. Such a reconfiguration of the listener recalls Salomé Voegelin's observation that:

> Vibration makes the world appear as an invisible field of connections within which my body *oscillates as a thing amid other things*. Vibration is the inexhaustible condition of this world that … binds me into its texture, not at its center, but in its weave.[33]

Notably, in a vibrational ecology, space is not treated as an empty container but rather as possessing materiality itself. Empty space – or more precisely, air – is a vibrational medium, one that transmits airborne sounds in the form of 'waves of pressure that radiate outwards', compressing, dispersing, and displacing air molecules.[34] A room is not only the setting of a work but an active participant in it, its material elements, volume, form, and connection to other architectural structures all actively shaping the transmission and transformation of energies in and through it.

Aesthetics and politics of material sound transmission

An aesthetics of material sound transmission privileges an engagement with the physical properties – such as the molecular densities and conductive potentials – of things; and an attunement toward how the material properties of things affect the propagation, transmission, and production of acoustic energy. It further invites an engagement with how the combination of various materials can influence the unfolding of energetic processes, for example through feedback or sympathetic vibration; or, to put it another way, the role that materiality plays in dynamic, complex, and potentially chaotic vibrational ecologies.

However, to focus only on the physical properties of materials would be to deny their politics and histories. Such aspects come to the fore in vibrational architectures that contend not only with the conductive capacities of materials, but also their cultural, political, and historical dimensions. The artist duo Mendi + Keith Obadike's *Praise Songs & Installations* (2000–present) – a series of works that pay homage to artists and activists who have transformed social consciousness around issues including race, nation, and power – includes several projects that engage both the sonic and vibrational capacities of architecture and the politics of architectural materials. In their sound art installation *Blues Speaker [for James Baldwin]* (April 1–30, 2015), for example, the Obadikes used 'the glass façade of The New School's University Center as a delivery system for sound, turning the building itself into a speaker'.[35] They transmitted a 12-hour composition that unfolded

between 9 AM and 9 PM on each day, transmitting the 24-channel work via three sides of the building's glass façade, 'wrapping' the building in sound which 'emanated' from the glass.[36] *Blues Speaker*, the Obadikes explain, included original blues songs they composed and performed; field recordings of ambient street sounds they recorded in Harlem; tuned sine tones that musicalised Baldwin's writings; and references to Baldwin's writing, including 'an inventory of sound contained in Baldwin's story "Sonny's Blues."'[37]

In a wide-ranging interview with Julie Beth Napolin, Keith Obadike explains that, over the course of the work's 12-hour cycle – a duration chosen to reflect the form of the 12-bar blues – 'there were sound events that happened once a day, moments of silence, dynamic volume swells as well as long looping elements'. He added that the 24 channels of audio were transmitted via three sides of the building:

> The idea was for the sound to wrap the building and emanate from the glass. The sounds chosen for each side of the building depended on how the space was used. For example, the glass wall on the west side of the building was next to a busy stairwell, but it was not next to a seating area like our other zones. This meant listeners would be passing through the area quickly, so we could occasionally do more pithy song-like gestures and low frequency material. In the zones where people sat and lounged we needed to do slower atmospheric moves with brief pauses and soft punctuations.[38]

Thus, the building's architecture, materials, and uses determined the poetics of the installation, which, as Mendi Obadike remarked, engaged the blues 'as a kind of knowledge, a way of processing the sorrowful news and coming out on the other side with information about survival'.[39] The Obadikes described their architectural rendering of the blues as social and political code – as knowledge and as 'feeling' – in both sonic and vibrational terms. Keith Obadike continued:

> We hope one of our contributions to the music through this mix of blues and sound art might be exploring the spatial and architectural possibilities of the blues. Our site for the *Blues Speaker* installation, The New School's University Center, has large glass panels tracing the walkways on all sides of the building. The glass is not just a functional portal, but also a design choice with social implications. We know that glass often represents a kind of utopian gesture in architecture. Some of these ideas came from Paul Scheerbart's *Glass Architecture* (1914). As we studied people moving throughout the building while looking down on a pulsing Manhattan, we wanted to vibrate those portals. We wanted to think about what the blues had to say to this structure; Baldwin gave us the lyrics.[40]

Blues Speaker [for James Baldwin] contended with the utopian modernist fantasy of a glass architecture, imagined by Paul Scheerbart in 1914 as embodying an 'open' culture that would put an end to the 'closed' culture of brick architecture, bringing this utopian impulse into dialogue with the blues – a language, code, and epistemology of survival.[41] Here, the physical capacity of glass to transduce and transmit sound across the surface of a massive structure was inflected by the social implications of a glass building, an architecture that strives for openness and liberation. *Blues Speaker* mapped the liberatory and survival codes of the blues, embedded within Baldwin's writings and the Obadikes' songs and soundscapes onto a building that itself embodies a liberatory impulse in its glass design. Glass functioned both as a physical portal connecting the internal rhythms and flows of the building with those of the pulsating city outside; and as an energetic or metaphysical portal that could be vibrated to evoke shared histories and futures of resistance and survival.

Anti-monumental architectures

The use of sound and acoustic energy to resist the political ideologies manifested in architecture underlined Jan St. Werner's *Space Synthesis* (May 5–July 2, 2023), for which St. Werner transformed Staatliche Kunsthalle Baden-Baden, a monumental neo-Classical building, into a continuously evolving 'sound space' and 'building that speaks'.[42] Maryanne Amacher's practice and her work with structure-borne sounds were important references for the exhibition. As the curator Çağla Ilk wrote, 'St. Werner develops an idea akin to structure-borne sound and takes this idea into the future by developing an innovative choreography that reduces the image and the intensity of a stage setting using a unique composition'.[43]

For *Space Synthesis*, St. Werner emptied the seven massive gallery spaces of the Kunsthalle, an imposing early 20th-century building designed to evoke a Roman temple, of nearly all visual imagery and cues. Various sonic, technological, and spatial interventions – electronic sound pieces projected over custom speakers that triggered a variety of psychoacoustic and spatial effects, producing a sense of shifting dimensionalities and perspectival flux[44]; a skylight mechanism that modulated the flow of natural light into the building, and an artificial light design that emphasised the interplay of light and shadow; and architectural interventions including 'unexpected walls that seem to be falling, raised floors, and a door that moves back and forth through the exhibition space'[45] – combined to produce an anarchic architecture of uncertain, modulating proportions.

Seeking to '[turn] the building into movement',[46] *Space Synthesis* achieved what might be called *structural flow*: the continuous, unpredictable, uncontrollable re-organisation of architectural space through the flux of shifting energies, including acoustic energy as it modulated architectural materials and forms. *Space Synthesis* challenged any sense of architectural stability and fixity, replacing monumental built forms with continuous spatial flux, movement, dissolution, and disintegration. Such a gesture has a political basis (Figures 17.1–17.5). As St. Werner wrote:

> *Space Synthesis* is also a practice against the idea of history as fixed knowledge which often manifests itself in monuments, rigid structures which no sound is strong enough to transform. It sets multi-perspectivity and dynamic interdependency in opposition to singular monumental thought and static histories. *Space Synthesis* is movement and assembly, manifold at its core, and it reflects an understanding of solid structures as porous and borders as transitional.[47]

Sonic materialities and architectural energies

Academic debates on sonic materiality have largely focused on the ontology (nature) of sound and its relationship to the analysis of music and sound art. In a much-cited article from 2011 Christoph Cox suggested that sound art had remained 'profoundly undertheorized' until then because prevailing theoretical models, which privileged textual and visual analysis and were oriented toward signification and representation, 'fail[ed] to capture the nature of the sonic'.[48] Cox proposed a materialist framework that added to addressing sound's material nature, a nature described by Cox in terms of flow and flux, as the 'ceaseless and intense flow' of matter'.[49] Cox pointed to the work of sound artists including John Cage, Alvin Lucier, Christina Kubisch, Toshiya Tsunoda, and others who explore '*the materiality* of sound: its texture and temporal flow, its palpable effect on, and affectation by the materials through and against which it is transmitted'.[50] He suggested that these artists' work revealed that 'the sonic arts are not more *abstract* than the visual but rather more *concrete*, and that they require not a *formalist* analysis but a *materialist* one'.[51]

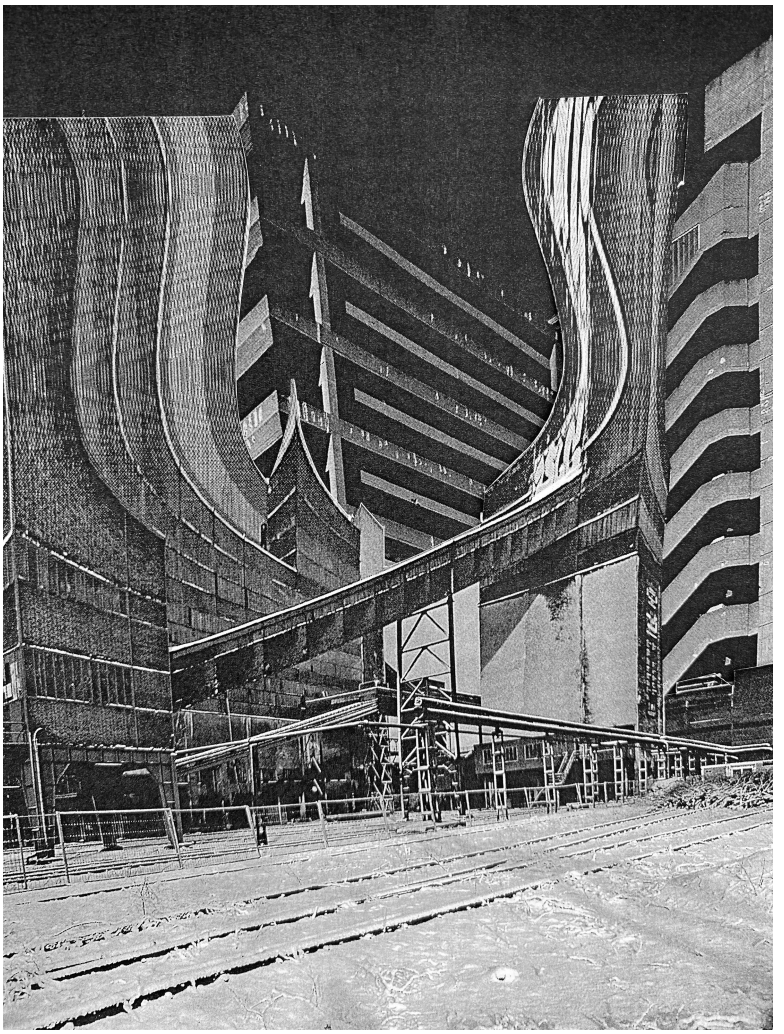

Figure 17.1 Vibraceptional architecture sequence 1 (2023) by Jan St. Werner. © Jan St Werner. Courtesy of the artist.

Cox's materialist philosophy of sound distinguished between sound art (concrete, materialist) and music (abstract, formalist) to enable a theorisation of sound art adequate to its concerns. While such a materialist framework rightly challenged the formalist leanings of much Western art music theory, it would be limiting, firstly, if we could not also understand music in materialist terms. Analysing music in connection to architecture, for one, invites a materialist approach. Music composed for specific architectural spaces such as churches or salons – whose acoustics are both contingent upon the material properties of those spaces as well as a key *determinant* of musical aesthetics – is a case in point. However, we might also consider music's intrinsic materiality, for example, its inextricability from the bodies and objects that produce and mediate musical sound.

Cox's materialist framework may have relied upon too-blunt distinctions between music and sound art; and scholars including Marie Thompson have raised issue with the 'white auralities' it

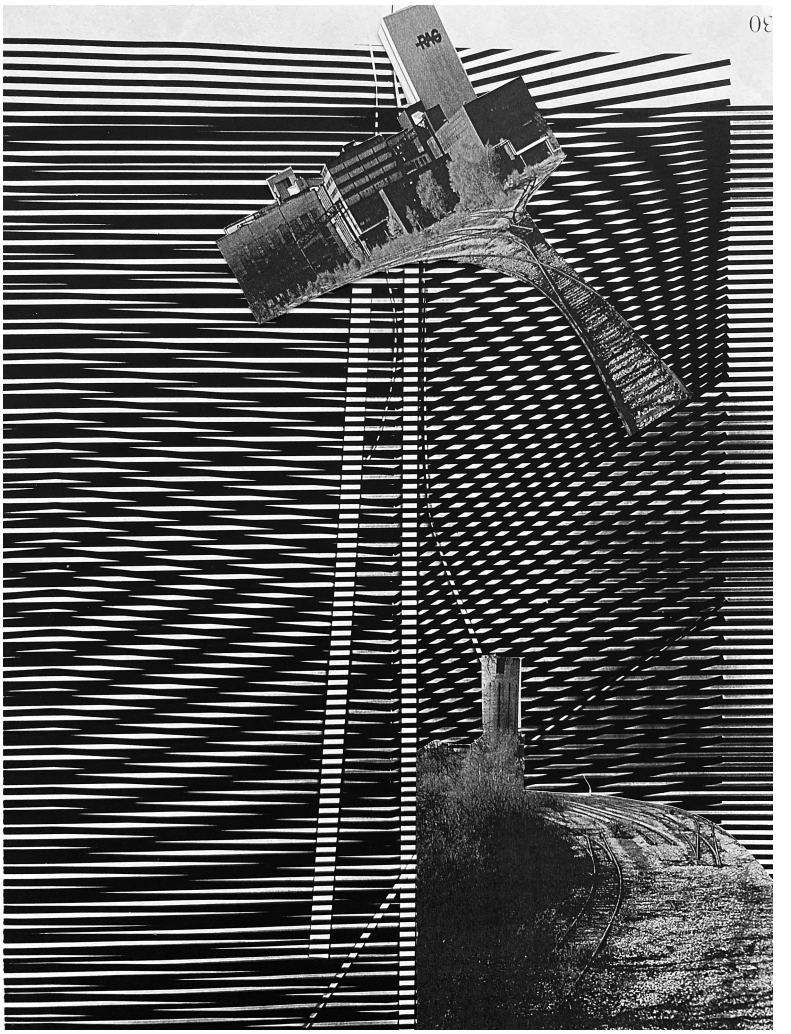

Figure 17.2 Vibraceptional architecture sequence 2 (2023) by Jan St. Werner. © Jan St Werner. Courtesy of the artist.

engages in embracing a post-Cagean aesthetics that privileges 'sound-in-itself' or sound beyond representation.[52] Still, it is a generative philosophy that, in considering the ontology of sound in relation to materiality, contends both with sound's intrinsic materiality or nature (its 'texture and flow') as well as its extrinsic materialities, as produced through transmission and mediation ('its palpable effect on, and affectation by the materials through and against which it is transmitted').[53]

We might, however, also consider the possibility that the ontology of sound is uncertain and in flux, residing somewhere between energy and matter, and able to assume either or both 'natures', which are normally understood as distinct states or categories of being. Where does the distinction between energy and matter lie in relation to sound? Douglas Kahn visits cognate territory in *Earth Sound, Earth Signal*, where he suggests that 1960s debates on materiality, immateriality, and the dematerialisation of the art object in the visual art world were inflected by the circulation of the art

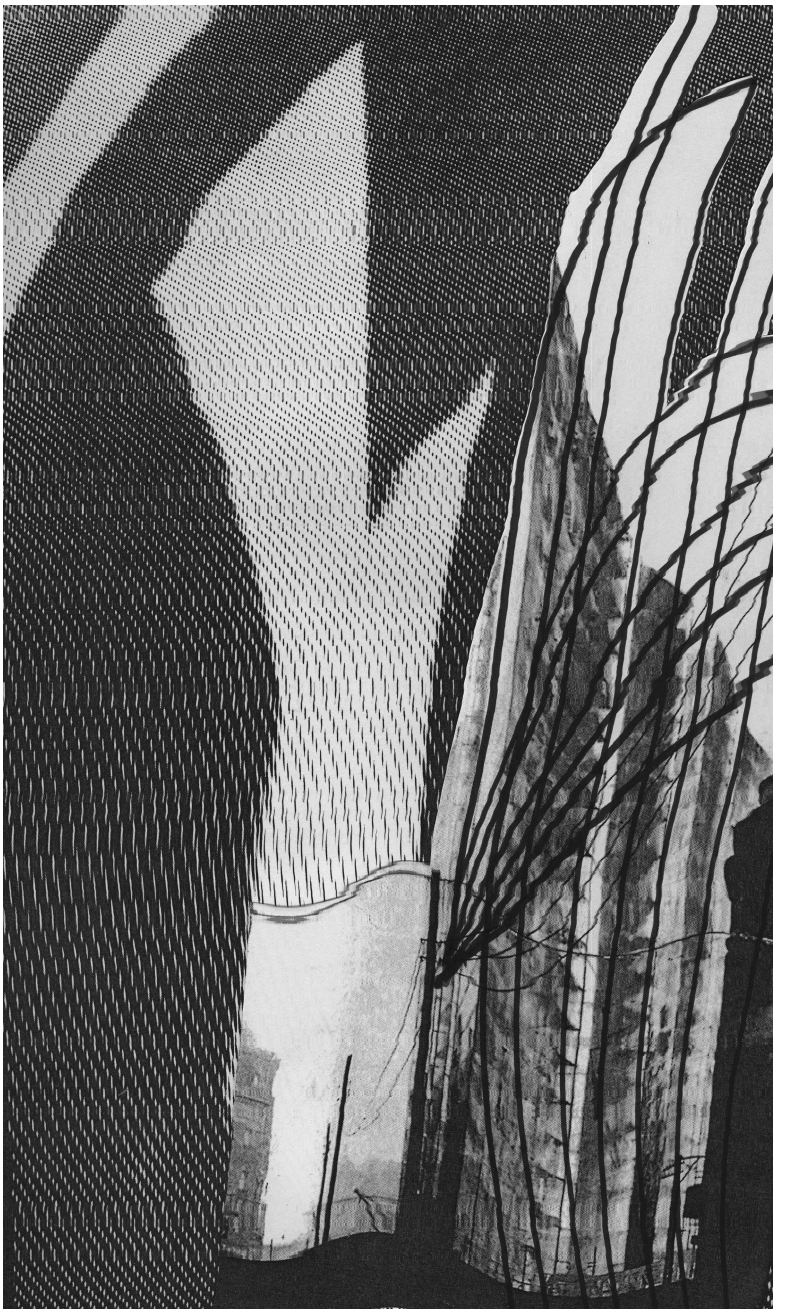

Figure 17.3 Vibraceptional architecture sequence 3 (2023) by Jan St. Werner. © Jan St Werner. Courtesy of the artist.

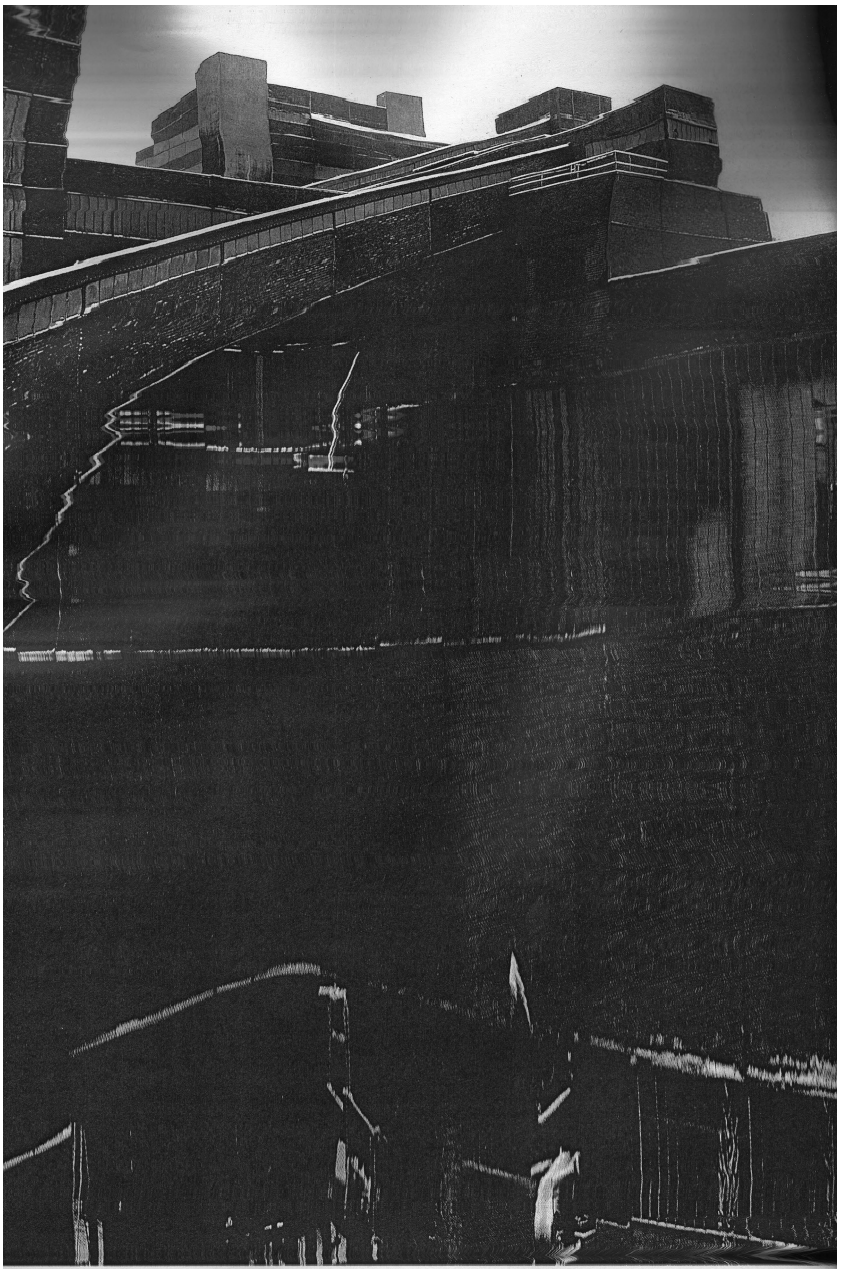

Figure 17.4 Vibraceptional architecture sequence 4 (2023) by Jan St. Werner. © Jan St Werner. Courtesy of the artist.

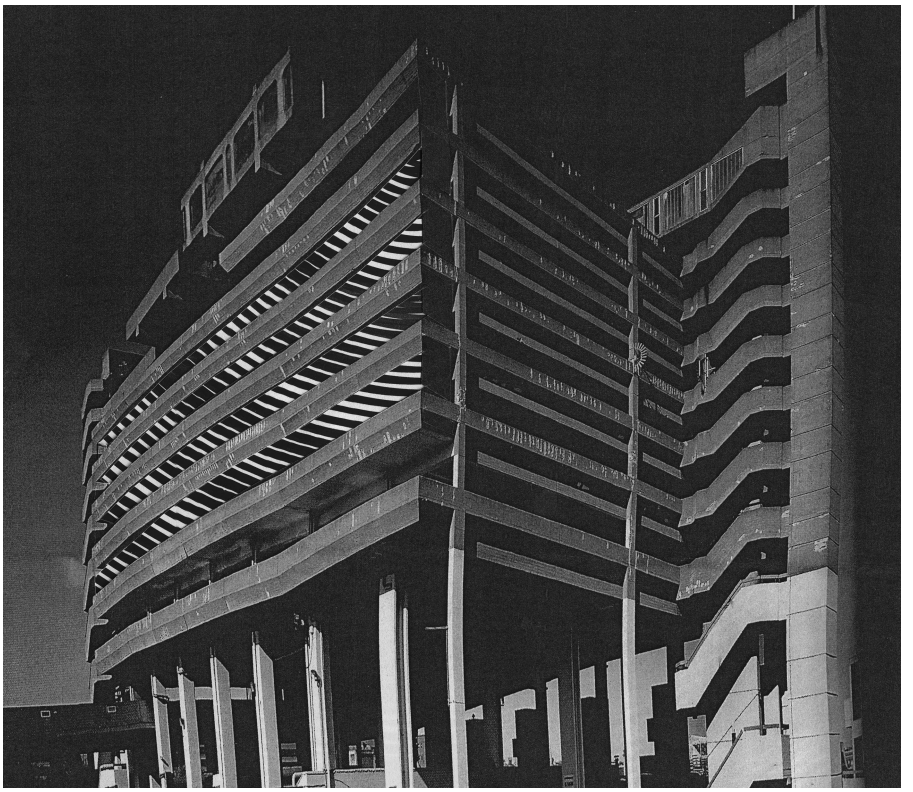

Figure 17.5 Vibraceptional architecture sequence 5 (2023) by Jan St. Werner. © Jan St Werner. Courtesy of the artist.

object as a commodity in the art market, whereas in music the situation was more fluid. 'Distinctions between matter and energy were never that pressing for music', writes Kahn.[54]

> The object-mission of musical instruments has always been to willingly dissolve between the surface of a page and performance space or to join the voice and vibrate in a complexly audible cosmos. Musical instruments are switching mechanisms, objects to be used at the disposal of energies. They are transductive objects.[55]

Taking a cue from the ontological looseness of music, then, the practice and study of architecture could shift attention from the materiality of the built form to the transient and the ephemeral – the energetic as it modulates, transforms, and reconfigures the material. Vibrational architecture, in which matter and energy intermingle in the realm of the built form, and which reveals architecture as comprised of shifting states of being, is a route toward understanding this.

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Notes

1 Michał Libera, 'Making the Walls Quake as If They Were Dilating with the Secret Knowledge of Great Powers,' accessed July 30, 2023, http://katarzyna-krakowiak.com/making-the-walls-quake/.
2 BiennaleChannel, 'Biennale Architettura 2012 – Michal Libera – Katarzyna Krakowiak,' *Video*, 4: 42 accessed July 30, 2023, https://www.youtube.com/watch?v=u2DK7fci8oA.
3 Karissa Rosenfield, 'David Chipperfield Announces "Common Ground" as the Theme for the 13th International Venice Biennale,' *ArchDaily*, January 17, 2012, https://www.archdaily.com/200806/david-chipperfield-announces-.
4 Irina Vinnitskaya, 'Venice Biennale 2012: Poland Pavilion,' *ArchDaily*, August 19, 2012, https://www.archdaily.com/264557/venice-biennale-2012-poland-pavilion.
5 Michał Libera, 'Making the Walls Quake', https://labiennale.art.pl/en/wystawy/making-the-walls-quake-as-if-they-were-dilating-with-the-secret-knowledge-of-great-powers/.
6 Michał Libera, 'Making the Walls Quake' [5].
7 Both the temporary wall and temporary floor that were installed for *Making the Walls Quake* were tilted at slight angles (though they were at 90 degrees to one another). As Krakowiak mentioned in conversation, this was done in part to encourage visitors to linger in the pavilion for a long time and physically interact with the architecture. Gascia Ouzounian and Jan St. Werner, unpublished conversation with Katarzyna Krakowiak, Zoom, July 18, 2023.
8 As Varèse proclaimed in 1936, when he imagined a 'spatial music' aided by electroacoustics, 'Music will eventually engulf and surround you.'
9 Marshall Long, *Architectural Acoustics* (Burlington, MA: Elsevier Academic Press, 2006), xxv.
10 For clarity, the material transmission of sound is treated in architectural acoustics, including by Sabine (1906); however, this is generally in relation to how sound transmitted through walls and partitions helps in the absorption of sound, and not as a productive or generative capacity of architecture. See Wallace Clement Sabine, 'Architectural Acoustics,' *Proceedings of the Academy of Arts and Sciences* 42, no. 2 (June 1906): 51–84.
11 Goodman, *Sonic Warfare: Sound, Affect, and the Ecology of Fear* (Cambridge: MIT Press, 2010), 75–76.
12 Goodman, *Sonic Warfare*, 76.
13 Goodman, *Sonic Warfare*, 75–76.
14 Goodman, *Sonic Warfare*, 76. In *Sonic Warfare* Goodman is particularly interested in the capacity of infrasound and very low frequencies to behave in such a way. He develops the concept of a 'bass materialism'—'practices of affective engineering through vibrational modulation' (p. 26)—and considers its role in sonic warfare.
15 See Gascia Ouzounian, *Stereophonica: Sound and Space in Science, Technology, and the Arts* (Cambridge: MIT Press, 2021), 83–104.
16 Goodman evokes the concept of a 'vibrational ecology' in relation to Mark Bain's work, writing, 'As opposed to a sound artist, [Bain] describes the sonic effects of his work as side effects, or artifacts, merely an expression of a more fundamental subsonic vibrational ecology.' Goodman, *Sonic Warfare*, 77.
17 Stefan Helmreich, *Sounding the Limits of Life: Essays in the Anthropology of Biology and Beyond* (Princeton, NJ: Princeton University Press, 2015).
18 Stefan Helmreich, 'Listening against Soundscapes,' *Anthropology News* (December 2010): 10.
19 Stefan Helmreich, 'Listening against Soundscapes,' 10.
20 Mark Bain, '*The Live Room*: Transducing resonant architectures,' *Organised Sound* 8, no. 2 (2003): 164.
21 Jonathan Tyrrell, 'Architecture's Acoustic Shadow: Unsettling the Sound-Space Relationship' (PhD diss., University College London, in progress).
22 Jonathan Tyrrell, 'Architecture's Acoustic Shadow.'
23 Jonathan Tyrrell, 'Architecture's Acoustic Shadow.'

24 Amy Cimini and Bill Dietz (eds.), *Maryanne Amacher: Selected Writings and Interviews* (Brooklyn, NY: Blank Forms, 2020), 224.
25 Maryanne Amacher, 'Living Sound (Patent Pending)', in *Maryanne Amacher: Selected Writings and Interviews*, Amy Cimini and Bill Dietz (eds.) (Brooklyn, NY: Blank Forms Editions), 233.
26 Maryanne Amacher, 'Interview with Jeffrey Bartone', in *Maryanne Amacher: Selected Writings and Interviews*, Amy Cimini and Bill Dietz (eds.) (Brooklyn, NY: Blank Forms Editions), 221.
27 Mark Bain, '*The Live Room*,' 163.
28 Mark Bain, '*The Live Room*,' 164.
29 Mark Bain, '*The Live Room*,' 165.
30 Mark Bain, '*The Live Room*,' 164.
31 Mark Bain, '*The Live Room*,' 166.
32 Mark Bain, '*The Live Room*,' 166.
33 Salomé Vogelin makes this observation in connection to Toshiya Tsunoda's *Scenery of Decalcomania* (2004). Salomé Voegelin, 'Sonic Materialism: Hearing the Arche-Sonic,' in *The Oxford Handbook of Sound and Imagination*, Mark Grimshaw-Aagaard et al. (ed.) (Oxford: Oxford University Press, 2019), 566.
34 Ed Yong, *An Immense World: How Animal Senses Reveal the Hidden Realms Around Us* (New York City: Vintage, 2022), 211.
35 Vera List Center for Art and Politics. 'Exhibition. Mendi + Keith Obadike: Blues Speaker [for James Baldwin].', accessed July 31, 2023, https://www.veralistcenter.org/exhibitions/mendi-keith-obadike-blues-speaker-for-james-baldwin.
36 Julie Beth Napolin, 'On *Blues Speaker [for James Baldwin]*: A Conversation with Mendi and Keith Obadike,' *Social Text*, August 21, 2018, https://socialtextjournal.org/on-blues-speaker-for-james-baldwin-a-conversation-with-mendi-and-keith-obadike/?platform=hootsuite.
37 Mendi + Keith Obadike, 'Praise Songs & Installations (2000–present),' accessed July 31, 2023, http://blacksoundart.com/#/praisesongs/.
38 Napolin, 'On *Blues Speaker*.'
39 Napolin, 'On *Blues Speaker*.'
40 Napolin, 'On *Blues Speaker*.'
41 Paul Scheerbart, 'Glass Architecture,' in *Glass! Love!! Perpetual motion!!!: A Paul Scheerbart Reader*, Josiah McElheny and Christine Burgin (eds.) (Chicago, IL: University of Chicago Press, 2014), 20–91.
42 e-flux Announcements, 'Jan St. Werner, *Space Synthesis*,' accessed July 31, 2023, https://www.e-flux.com/announcements/527930/jan-st-wernerspace-synthesis/.
43 Çağla Ilk, 'The Shadow of Ideas,' in *Jan St. Werner: Space Synthesis*, Çağla Ilk and Jan St. Werner (eds.) (Berlin: Hatje Cantz Verlag, 2023), 32.
44 Jan St. Werner, *Space Synthesis* album, Bandcamp, accessed July 31, 2023, https://fiepblatter.bandcamp.com/album/space-synthesis.
45 Ilk, 'The Shadow of Ideas,' 32.
46 See Gascia Ouzounian, 'Unfolding Spaces: A Wayfinding,' in *Jan St. Werner: Space Synthesis*, Çağla Ilk and Jan St. Werner (eds.) (Berlin: Hatje Cantz Verlag, 2023), 90.
47 Jan St. Werner, 'Space Synthesis,' in *Jan St. Werner: Space Synthesis*, Çağla Ilk and Jan St. Werner (eds.) (Berlin: Hatje Cantz Verlag, 2023), 39.
48 Christoph Cox, 'Beyond Representation and Signification: Toward a Sonic Materialism,' *Journal of Visual Culture* 10, no. 2 (2011): 145.
49 Brian Kane, 'Sound Studies Without Auditory Culture: A Critique of the Ontological Turn,' *Sound Studies* 1, no. 1 (2015): 9.
50 Cox, 'Beyond Representation,' 148.
51 Cox, 'Beyond Representation,' 148–149, emphasis in original.
52 Marie Thompson, 'Whiteness and the Ontological Turn in Sound Studies,' *Parallax* 23, no. 3 (2017): 266–282.
53 The capacity of sound to affect materials has shaped debates about its ontology since at least the early modern period. The English natural philosopher Francis Bacon, for example, remarked that '"Audibles" (sounds) had the power to disturb a medium like water or air, whereas "Visibles" (light) did not. In contrast to light, sound could disturb a medium and produce changes in it—in other words, "affect" and "corrupt" it.' See Gascia Ouzounian, 'Becoming Air: On Sonic Spatial Metaphysics,' in *Sound – Space – Sense*, eds. Diedrich Diederichsen, Arno Raffeiner, and Jan St. Werner (Berlin: Haus der Kulturen Welt, Das neue Alphabet/The New Alphabet series, 2023), 17–18.

54 Douglas Kahn, *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts* (Berkeley: University of California Press, 2013), 218.
55 Kahn, *Earth Sound Earth Signal*, 218.

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