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Frank Lloyd Wright's intuitive sound modernity

Jack Quinan

Visual Studies, Department of Art, University at Buffalo, The State University of New York, Buffalo, New York, USA
(Author's e-mail address: quinan@buffalo.edu)

This essay examines Frank Lloyd Wright's youthful immersion in classical music and his subsequent five-year employment under Dankmar Adler of Adler & Sullivan as prelude to a career in which Wright worked intuitively with the acoustics of theatres and other large spaces for sound as well as domestic commissions, despite parallel developments in the science of acoustics from Wallace Sabine to Vern O. Knudsen. The conclusion determines that while Wright's largest sound spaces, such as the 3,000-seat Grady Gammage Auditorium, required the assistance of Knudsen, his domestic works were more successful acoustically than those of the leading European modernists, Le Corbusier, Mies van der Rohe and Walter Gropius.

Introduction

Whilst there is no question that Frank Lloyd Wright's work during the Prairie period manifested numerous constituent elements of architectural modernism there has been no sustained examination of Wright's acoustics in relation to a notion of sound modernity in domestic architecture, his primary field. Moreover, although he eventually realised more than forty performance and religious spaces over the course of his career, Wright remained steadfastly dismissive of Wallace Sabine's acoustical science.

In her landmark study, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933*, Emily Thompson identifies Sabine's pioneering work to correct the excessive reverberation in the Fogg Art History lecture hall at Harvard University with the initiation of the science of acoustics.¹ Sabine's work coincided with the development of Frank Lloyd Wright's Prairie

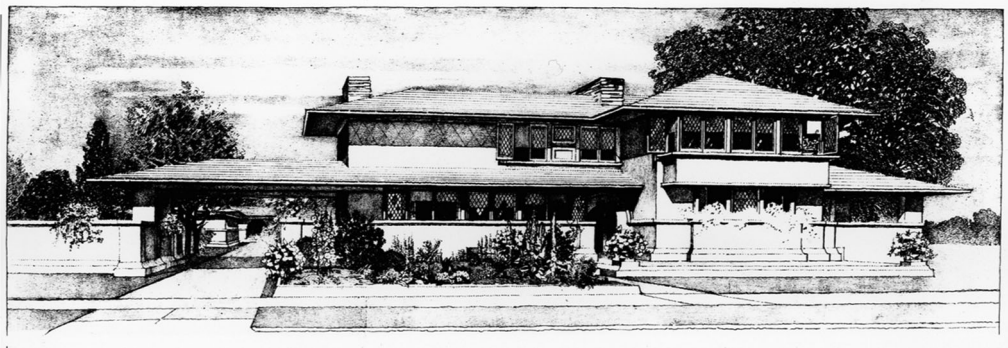
House (figs 1a, 1b), a design that radically altered the nature of American domestic architecture, inspired modernist architects abroad and crystallised a theory of organic architecture that served Wright throughout his career.

This essay will draw from Wright's own writings, recorded interviews and building designs to examine his engagements with the sound of modernity, revealing the depth of his youthful immersion in music and the influence of Dankmar Adler's intuitive approach on Wright's subsequent domestic architecture.

Wright's formative years

Wright attributed much of his success in architecture to his mother, Anna Wright, a school teacher who doted on him, encouraged him to be an architect,² instructed him in the Froebel Kindergarten method, and introduced him to literature and to nature.³ His father, William Wright, was trained as

Figure 1a. Plan, "A Home in a Prairie Town," *Ladies' Home Journal*, (Feb. 1901, p. 17), The Frank Lloyd Wright Foundation Archives (The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).



a lawyer but functioned variously and rather haplessly as a Baptist minister, music teacher, well-published composer and occasional maker of violins. Wright's account opens with his father playing a Bach piece on a church organ while his seven-year-old son labours at a bellows in a compartment behind the organ crying in fear of failing his father as he tries to sustain the music. When the service ends William Wright and his son walk home in silence to face the wrath of Mrs. Wright. The passage indicates that Wright came to know the music of Bach viscerally: 'Father sometimes played piano far into the night, and much of Beethoven and Bach the boy [Wright] learned by heart as he lay listening. Living seemed a kind of listening to him—then', and in these few lines—'Father taught him to see a symphony as an edifice—of sound!'⁴—Wright challenges the predominance of the visual in architecture with the auditory and indicates that his first exposure to the idea of synthesis in the arts was through musical composition.

Wright developed a particular fondness for the music of Beethoven to whom he often compared himself:⁵ 'When I was a small child I used to lie awake listening to the strains of the Sonata Pathétique—Father playing it on the Steinway square downstairs in the Baptist minister's house at Weymouth. ... When I build I often hear music and, yes, when Beethoven made music I am sure he sometimes saw buildings like mine in character, whatever form they may have taken then.'⁶

William Wright transported his family across five states in nine years from one Baptist congregation to another. By 1885 the family was living in Madison, Wisconsin, where Wright attended high school and briefly studied engineering at the University of Wisconsin. In 1887 he moved to Chicago where, following a year in the office of J.L. Silsbee, he was hired by Adler and Sullivan to work on the prestigious Chicago Auditorium Building. Within three years Wright, aged 23, was made chief of the firm's thirty draftsmen.

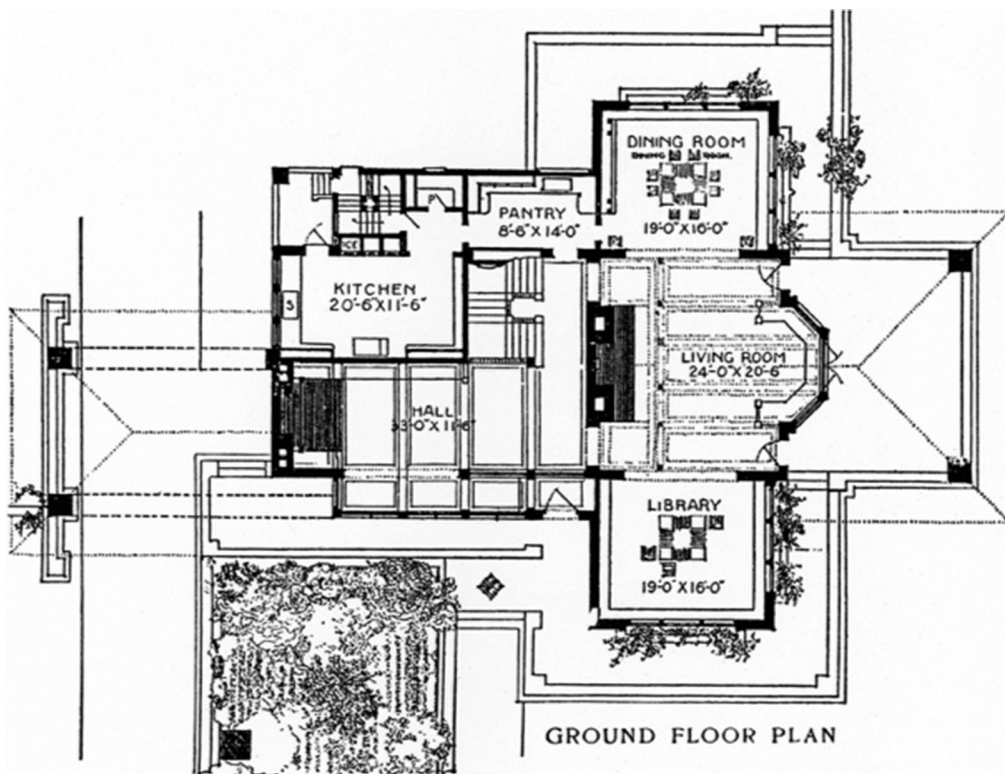


Figure 1b. Elevation, "A Home in a Prairie Town," *Ladies' Home Journal*, (Feb. 1901, p. 17), The Frank Lloyd Wright Foundation Archives (The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).

Adler and Sullivan won the Auditorium commission in part on the strength of Dankmar Adler's knowledge of acoustics which he had augmented by an intensive two-month tour of thirteen theatres and opera houses in five European countries.⁷ Wright recalled: 'I went to Adler & Sullivan during the building of the Chicago Auditorium and did the finished drawings for it. Then came theater after theater. Adler & Sullivan built over thirty

when I was with them. I knew acoustics, all that Dankmar Adler knew, and he was the master of acoustics in this country, recognised as such.'⁸

Developing an intuitive practice

Wright left Adler & Sullivan in 1893 and established a successful domestic practice. Following the publication of 'A Home in a Prairie Town' in the *Ladies' Home Journal* in 1901, his office

production accelerated to an average of ten to twelve Prairie houses per year and ten non-residential commissions of various types and sizes up to 1909. The latter presented a variety of acoustical and ambient sound conditions that required various degrees of modulation, enhancement or refinement depending upon the building's function and location.⁹ The disparate nature of these commissions suggests that Wright moved fluidly between domestic and non-domestic realms while maintaining a consistent concern with acoustics in the home, an intimate, personal realm in which his quest for a total sensory experience could be fully realised.

Musical instruments became a second 'hearth' in his houses. Despite his early success, Wright abandoned his family with Catherine Wright and their six children in 1909 and departed for Europe with Mamah Cheney, the wife of a client, precipitating a long hiatus in which he was beset by negative publicity and lawsuits that frustrated his ability to obtain and realise many new commissions until the mid-1930s.¹⁰ During this period, from 1909 to the mid-1930s, music was a persistent presence and perhaps something of a solace to Wright, who seemed to crave music in his life and managed to acquire pianos for his living quarters in Tokyo, for the rough-hewn Arizona desert camp, 'Ocatillo', in 1927 and for the newly constructed drafting room at Taliesin West in 1937. By 1959 there were a dozen pianos at the two Taliesins, six of them of the first quality.¹¹

In 1937 Wright formed a family orchestra while staying at the Jokake Inn in Scottsdale, Arizona, just as he had done with his first family in the Oak

Park days and as *his* father had done in the 1880s.¹² When he and Mrs Olgivanna Lloyd Wright, an accomplished composer,¹³ formed the Taliesin Fellowship in 1932, applicants were expected to be able to sing or play an instrument in addition to their drafting abilities.¹⁴ This requirement led to the formation of the Taliesin orchestra and chorus, weekly musical evenings featuring the work of classical composers and summer residencies for ensembles of musicians from Madison, Chicago and New York. Wright even had speakers mounted on the belvedere, a tower on the hilltop behind Taliesin, so that the music of Beethoven and other composers could be broadcast across the fields for the edification of the apprentices and farmers.¹⁵

Given Wright's youthful immersion in classical music and his association with Adler, one has to wonder just how music and acoustics influenced Wright's career subsequently. According to Sullivan, Adler's acoustical work was entirely intuitive: 'I then discovered what Mr. Adler knew about acoustics. ... I found out the extent of Mr. Adler's knowledge in connection with that building [the Chicago Auditorium]. It was not a matter of mathematics, nor a matter of science. There is a feeling, perception, instinct, and that Mr. Adler had ... a grasp of the subject... which he could not have gained from study, for it was not in books.'¹⁶ Wright's admiration and respect for Adler (the 'Old Chief') is evident in *An Autobiography*: 'He commanded the confidence of contractor and client alike. His handling of both was masterful. He would pick up a contractor as a mastiff might pick up a cat—shake him and drop him. Some would habitually fortify themselves with

a drink or two before they came up to see him. All worshipped him.¹⁷

Evidence that Wright continued on Adler's intuitive path throughout his career, in parallel to the scientific approach of Sabine and his successors, appeared in 1951 when Ling Po, an apprentice, asked Wright about the laws of acoustics:¹⁸ 'My dear boy, I'm no expert. I couldn't tell you anything about acoustic laws. I could only tell you what would work according to my idea, and what wouldn't. Founded upon what I learned from Old Dankmar Adler, chiefly and what's happened to me since in little wayside experiments.'¹⁹ It is significant that Wright, in his role as teacher to his apprentices, then expounded at length on Adler's acoustical methods (condensed in his conclusion to 'deadenthe surfaces, expand the house, make the air currents work with you ...'²⁰) some fifty years after Adler's death and well into the institutionalisation of acoustics as a science.

From sound in theatres to the sound sphere of houses

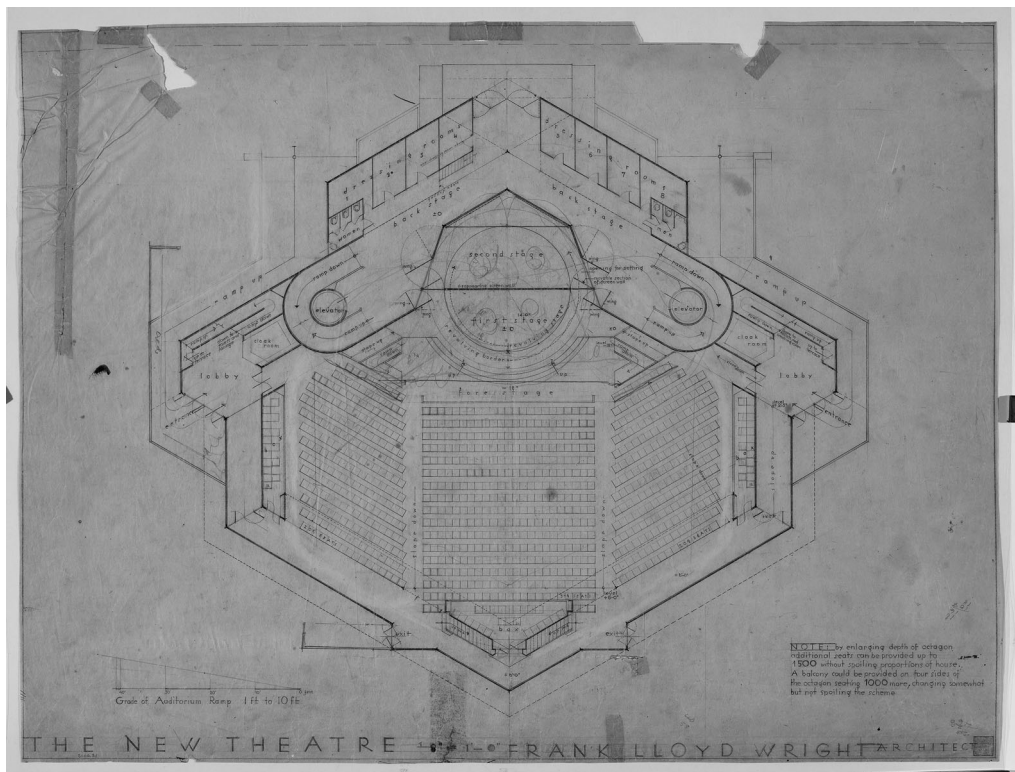
Theatre design with Adler & Sullivan and on his own provided Wright with the opportunity to develop and refine the intuitive sound consciousness that he carried over to his domestic architecture. Sound in domestic settings did not have to be as carefully calibrated as in the theatre but it had to be managed. Theatre held a special significance for Wright, modelled by the theatrical aspects of his father's and Uncle Jenkin's preaching, his mother's teaching and his own participation in the *Esteddvod* at family gatherings.²¹ As a boy he professed an interest in becoming an actor,²² and as a commuter

into Chicago for many years he carried a pocket edition of Shakespeare's plays.²³ Joseph M. Siry, an authority on Wright's and Adler & Sullivan's theatres, auditoria and religious buildings, has observed that Wright held theatre in high regard as the gathering place of all the arts—literature and poetry, stage design, music and architecture.²⁴ Citing a Wright apprentice, Kelly Oliver, Siry stated that 'Frank Lloyd Wright loved the theatre. Of all its many forms his first love was the small intimate theatre that was more like a living room.'²⁵

Siry traces Wright's efforts to create a New Theatre through three versions: The first, for Woodstock, New York in 1931 (Fig. 2), was small, intimate in size (774 seats and some box seats) and mechanised to speed the changing of scenery. Sound quality was enhanced by the elimination of the proscenium, the projection of the stage apron towards the audience and the extension of a sounding board out over the audience. When that commission failed to materialise Wright found a second potential client in Hartford, Connecticut, in 1948, but that venture also failed. The New Theatre was finally realised as the Dallas Theatre Center in 1959 where Wright exchanged the sounding board of the two previous designs for a ceiling of suspended, 4-inch thick concentric arcs of concrete faced with acoustical plaster (Fig. 3) radiating outward from the stage to form a graphic rendition of sound waves—a mutually reinforcing synthesis of sight and sound.²⁶

Having grown up in a house of music where he absorbed the music-as-architecture metaphor, Wright's interest in a synthesis of domestic architecture with music and theatre was manifested as early as 1895 in the children's playroom of his Oak Park

Figure 2. Plan, New Theater, Woodstock, N.Y., 1930, The Frank Lloyd Wright Foundation Archives # 3106.021 (The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).



home and developed over numerous subsequent commissions.²⁷ Wright's desire to enfold music into his own domestic life culminated, however, with the formation of the Taliesin Fellowship in 1932 for which he would eventually design five theatres.²⁸ The Fellowship became an extension of the architect's life and practice in which the theatres served multiple functions: those of consolidating the

relationship of music to architecture for the Fellowship members, of providing a venue in which the Taliesin community could gather and entertain one another and as an attraction to prospective clients. They were encouraged to visit and stay at Taliesin where the combination of Wright's buildings, the landscape and the pervasiveness of music powerfully affected many of the clients who came because they



Figure 3. Interior photo, Kalita Humphreys Theater, Dallas, TX, 1959, The Frank Lloyd Wright Foundation Archives #5514.0018 (The Museum of Modern Art I Avery Architectural & Fine Arts Library, Columbia University, New York).

were themselves musicians or aficionados of serious music.²⁹

Two theatres: refining acoustics through trial and error

Two of the theatres that Wright designed for the Taliesin Fellowship ('little wayside experiments')³⁰ enabled him to refine acoustics through trial and error. At the Hillside Playhouse at Taliesin (1951; Fig. 4) he inserted a five-tiered V-shaped seating

arrangement that embraced an orchestra pit projecting forward from the stage. Audiences of 180 sat in close proximity to the players where, from either wing of the 'V' of seats, one half of them viewed simultaneously the players and the other half of the audience, compounding the visual-aural experience while enhancing the sense of intimacy.³¹ Sound resonating from a wooden floor over a volume of space reflected off a wooden sounding board projected over the stage towards the audi-

Figure 4. Interior,
Hillside Theater,
Taliesin, WS, 1952
(Photo: author).



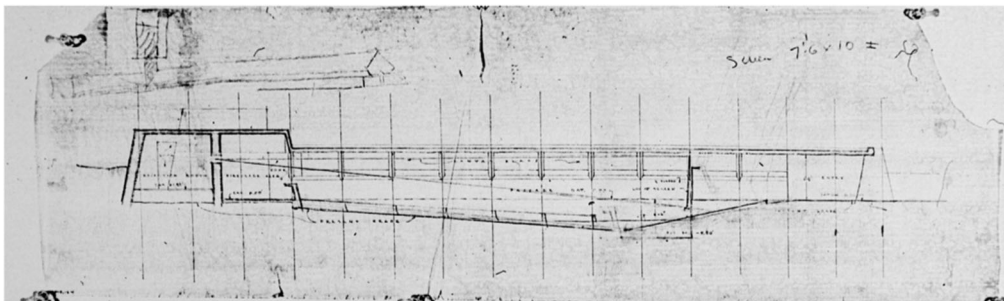


Figure 5. Longitudinal Section, Cabaret Theater, Taliesin West, Scottsdale, AZ, 1952, The Frank Lloyd Wright Foundation #3803.164 (The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).

ence. Wright described the resulting acoustics at Hillside as 'some interesting experiments in sound—reflexes ending up with the loudspeakers beneath the stage pointing toward the rear wall of the recess in which the screen stood. Sound to permeate the house instead of hitting hard on the ear. From

this backboard wall, the sound—now a reflex—spread to the audience. Integral sound.'³²

In 1949 Wright designed the Cabaret Theater at Taliesin West,³³ a small, self-effacing building unlike the larger 'New Theater' designs of 1931 and 1948, but quite ingenious in its own way. The

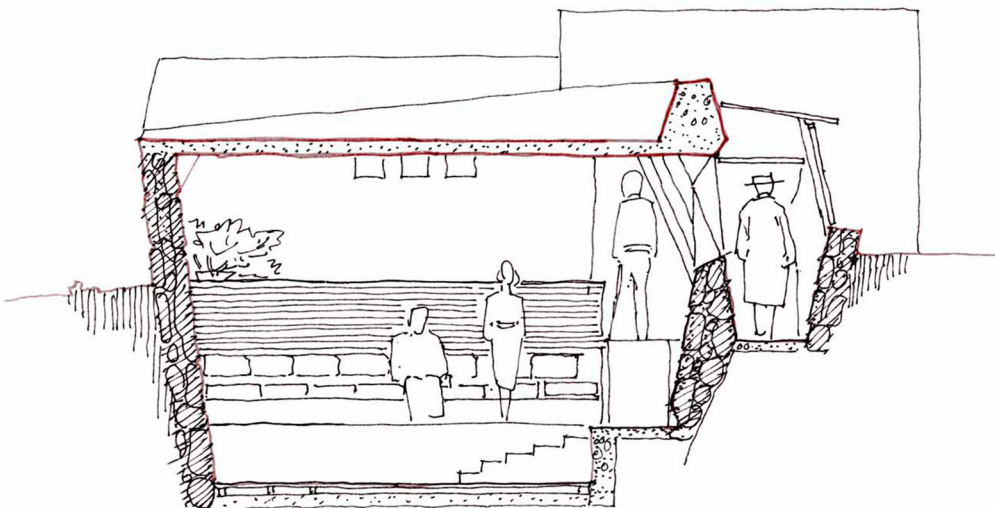
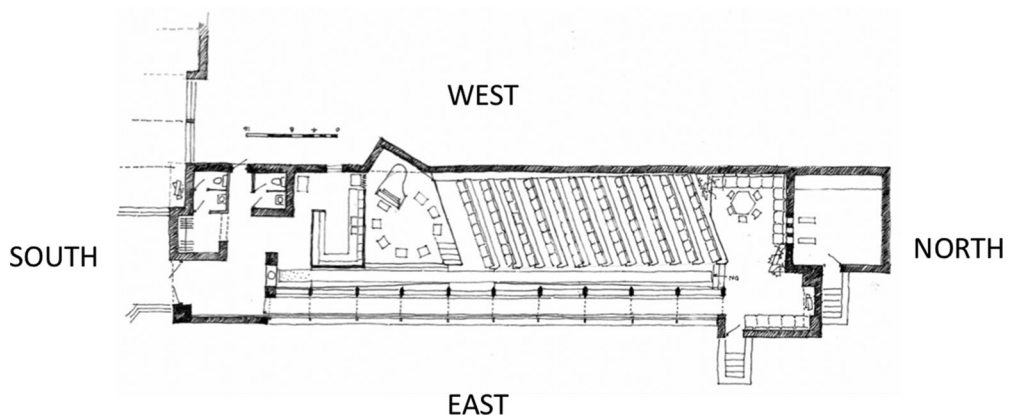


Figure 6a. Latitudinal section drawing by Curtis Besinger, Cabaret Theater, Taliesin West, Scottsdale, AZ, 1952, call # MS 241 D Folder 22.16. (Curtis Besinger Collection, Kenneth Spencer Research Library, The University of Kansas Libraries).

Figure 6b. Plan,
Cabaret Theater,
Taliesin West (Curtis
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oversize).



Cabaret (figs 5, 6a, 6b) is a 94' by 24' oblong structure of desert-masonry,³⁴ partially submerged below the desert floor. Its flat roof is accented by battered pylons at the south (main) entrance and a two-foot rise in elevation at the north end that accommodates a dining platform, film projection booth and fireplace. Although the general shape of the Cabaret is a 'shoe box configuration' its west wall tilts 20 degrees west of perpendicular while the east side of the building leans outward as a battered stub wall from which eight reinforced concrete braces angle inward to support the roof slab (Fig. 6a). A dining platform to the rear overlooks ten descending tiers of angled seating, for an audience of approximately 75, that are accessed by a ramp alongside the building's east wall. Owing to the slope of the seating the ceiling height is six feet six inches at the uppermost tier and nine feet at the bottom tier. The stage floor is a resonating wooden floor over a void.³⁵

The main entrance to the Cabaret (see Fig. 6b) leads to a gallery that traverses the outside of the east wall to the dining platform where it turns 180 degrees and descends as a ramp to the seats. The gallery is enclosed to the east by another outwardly-tilted spur wall that supports an inward-leaning metal frame that carries a glazed roof and inward-leaning plywood panels (originally of canvas). These swing upwards to open the gallery to the outdoors. The panels that line the inner side of the gallery are also hinged so as to swing upward to close each of the broad 6'4" x 3'4" openings between the concrete braces that support the Cabaret roof and enclose the Cabaret interior. These panels allow for the creation of differing day and evening light and weather conditions as well as acoustical adjustments in that the panels on the east side of the interior can be closed to form a horizontally indented surface less susceptible to sound reflection than a vertical flat surface would be.

An apprentice, Curtis Besinger, observed that, because the two long walls are wider at the ceiling level than at the floor level and the floor slopes downward toward the stage, a forced perspective results that negates the tunnel-like nature of the space,³⁶ another synthesis of the visual with the acoustical in order to enhance the audience experience. In a similar vein, Wright had the film projector in the Cabaret altered so that the audience would see the sound track as well as the film.

In the 1951 interview Wright described the articulation of the Cabaret ceiling as 'like putting tension in the head of a drum, ... Then the ceiling was a little hard and a little bare so I put those free-standing strips running across the ceiling—across the sound, much as you'd tighten a violin string on a fiddle. Now, just what they do, I don't know. But they do something. Because the sound is very much—more resonant after that, than it was before.'³⁷ A photograph from the 1960s (Fig. 7), reveals a series of six pairs of wooden dowels that extend from the piers on the east (right hand) side of the interior to the ceiling's midpoint where they were fastened to one of six 31" by 9" plywood sheets to which six Chinese paintings on silk were attached. This unusual apparatus represents the 'free standing strips' to which Wright refers as 'running across the ceiling—across the sound'³⁸ and with which he attempted to modulate the sound in the Cabaret.

Sound in the Domestic realm

In leaving the offices of Adler & Sullivan for an independent practice dominated by domestic commissions Wright moved from realms of design in

which the projection of music and voice were carefully calibrated, to homes in which the predominant sound was non-musical. Yet even as he created the first Prairie house in 1901 the proliferation of electrically-operated machines and devices—telephones, gramophones, wirelesses, vacuums and motor vehicles—were dramatically altering the interior and exterior soundscapes of modern domestic life.³⁹

The nineteenth-century legacy of American domestic architecture was a parade of historical revivals in which interiors were comprised—with some notable exceptions⁴⁰—of an assemblage of box-like rooms. Wright's first Prairie house (see figs 1a, 1b) was revolutionary in that it opened the principal living spaces of the first floor into a nearly continuous space even as the soundscape of the domestic interior was being contested by the intrusive sounds of these new machine-age technologies. Wright's open plan seems *counter-intuitive* and posed a new acoustical challenge—*how to modulate the resulting domestic soundscape?* The answer to this question requires some prefatory considerations:

A rectangular room with a flat ceiling and hard surfaces produces undesirable reflections that have traditionally been muted by carpets, curtains, upholstered furniture and other decorative features. Moreover, Wright's concern with sound in the home is but one facet of his concurrent concerns with the visual, tactile and kinaesthetic senses within the totality of the design process.

As practical design strategies Wright extended the open-planned Prairie houses laterally on their sites, with cross-axial plans (or variants of them) to diffuse sound over distance as sonic decay in con-

Figure 7. Interior,
Cabaret Theater,
Talesin West, Frank
Lloyd Wright
Foundation
#3803.4167.



trast to the verticality of the Victorian and Renaissance Revival traditions of the era.

Prairie house rooms were frequently designed with indeterminate boundaries, as in the Darwin Martin and Allen-Lambe houses where structural pier clusters rather than walls with right-angled corners diminished reflection. Materials, structural elements and features were used to minimise and control reverberation and reflection. Subtle textures of wood, sand-floated plaster, art-glass windows and furniture fabrics absorb sound. Fine slatted

wooden screens, spur walls and lowered horizontal beams in transitional spaces act as baffles and filters while discretely defining individual spaces.

Wright manipulated the shape of domestic spaces with impunity, using barrel vaults (Dana House), shifted ceiling planes (Robie House) and ceilings shaped by gables (Heurtley house) and gambrels (Little House #1). Floor levels were shifted as well in numerous houses. Lowered ceilings and horizontal beams in transitional spaces create interior landscapes in which subtle changes in sound quality

(along with the physical sensation of compression and release) from space to space comprised one facet of Wright's desired experiential totality.

Simple lath-like wood mouldings were used to articulate the contours of ceilings and walls, often directed movement, and functioned acoustically. Working within the contexts of his two primary domestic prototypes, the Prairie house and the Usonian house, Wright continued to innovate intuitively.

As a first conclusion it must be recognised that Wright worked with sound at multiple levels in his houses: at a practical level, with design strategies modulating sound in the open plan (by the expansion and compression of contiguous spaces, the shaping of rooms and shifting of floor levels, the extensive use of unpainted wood and sand-textured plaster, extensive use of dropped beams between rooms, piers, posts and fine wooden balusters); at a conceptual level, in envisioning the home as a place for music; at a metaphorical level on which the house can be experienced as music.

Taliesin, a place for music (1911–1914—1925ff)

In 1934 Wright expressed a desire to synthesise architecture and music in the home: 'More and better music a la camera (music in a room—room at home I say) is a necessary factor in more and genuine culture.'⁴¹ The living room at Taliesin epitomises these intentions with an astonishing space calculated to appeal to potential clients, and for entertaining friends and the edification of Taliesin's apprentices. The current post-1928 Taliesin living room accommodates social functions for up to 75 people yet maintains an exceptional intimacy.⁴² As

initially designed in 1911 the living room was a single-storey space 18' 8" wide by 36' 6" in length rising approximately 12 feet beneath a prairie-style roof perched on the brow of a hillslope above apprentice living spaces. Following the 1914 fire the footprint of the living room remained the same but after the 1925 fire the space was widened and the roof was reconfigured so that a new gable at the northeast end gave way to a higher gable reaching 16 feet at the opposite (dining) end where the space trails off into a two-storey cleft that would diffuse sound wave reflection.

The grand piano (Fig. 8; covered by a white sheet to the lower left in this photograph) is located in the northwest 'corner' of the Taliesin living room under a smooth plaster plane that forms one half of the ceiling gable, the opposite plane of which is interrupted by an extruded fold striated with lath-like wooden mouldings. In view of Wright's conviction that the ceiling mouldings in the Cabaret at Taliesin West 'do something' to the sound (though he doesn't know what), the differing treatments of the two ceiling surfaces in the Taliesin living room appear to be sound-related. The fold in the pitched ceiling and the mouldings act as a textural deterrent to sound reflection even as they form a lively visual abstraction. That Wright's (and Adler's) intuitive approach to sound belongs to a long-standing pre-scientific tradition is supported by Michael Forsyth's observations of the Residenz Theater (1751) in Munich where the decoration, 'is entirely modeled. Such decoration in old theaters and concert halls has the useful acoustic function—unknown to their original architects—of scattering, or 'diffusing', the reflected sound in several directions.(fn 6)

Figure 8. Living room,
Taliesin, Spring Green,
WS, 1925ff (Photo
author).



Modern auditoria are often designed with a broken wall surface, *sometimes in the form of abstract decoration, for the same reason*. [Italics added]⁴³ Wallace Sabine made a similar case in the essay 'Architectural Acoustics', where he describes how sharp reflections from the smooth surfaces of a cylindrical church ceiling were corrected by coffering the ceiling.⁴⁴

The Coonley House —the house as music (1908)

The analogous relationship of architecture and music that Wright absorbed from his father is epitomised in the Avery Coonley House (1908) of which he said: '[It is] the most successful of my houses from my standpoint.'⁴⁵ The principal living spaces of the Coonley House are elevated a full storey above grade where eleven of its fourteen rooms have ceilings formed by their enclosing gabled and hipped roofs. The plaster ceiling of the living room [Fig. 9], the largest space in the house at more than 900 square feet, is a semi-pyramidal hipped configuration that acts as a resonant membrane owing to its suspension from the roof structure. The ceiling mouldings evoke spreading tree branches abstractly and tie them visually to the fern-and-birch mural that flanks the fireplace and to the panoramic vista of plants and trees beyond the windows that wrap nearly three sides of the room. The ceiling mouldings also organise the central space of the room and, like those in the Cabaret at Taliesin West and the Taliesin living room, 'do something' to temper the sound of the piano (that used to be in the southwest corner of the room). Dean Eastman, who has restored the Coonley House, writes that based upon his installa-

tion of a hifi system, 'The acoustics in the living room is outstanding; the sound is very uniform throughout the large space ...'⁴⁶

To ascend to the main living floor of the Coonley House and move through the pulsating shapes of its spaces is to experience architecture as a *form of music* choreographed by subtle changes in ambient sound caused by the shifting ceiling heights, the width and shapes of spaces, the textures of floor surfaces, and the wooden mouldings that guide and arrest one's movement as the case may be.

Grant Hildebrand has explored the house-as-music analogy in Frank Lloyd Wright's Palmer House (1950), where, in recognition of the obvious disparities between architecture and music, he proposes making an analogy between the Palmer House and Beethoven's music '*abstractly* —as opposed to our experiential perception of it', and builds a compelling case in terms of shared themes, progressions, modular systems and such qualities as 'entity, oneness in diversity, depth in design, [and] repose in the final expression of the whole'.⁴⁷ Wright's concern with acoustics was not confined to the interiors of his houses, however.

With the first Prairie house in 1901 Wright established the principle that the interior spaces of his houses would be as continuous with the exterior environment as possible, considerations of privacy and weather notwithstanding. He exploited natural opportunities wherever they occurred on building sites and introduced nature into the homes in the form of plants, flowers, tree branches, wood grains and water features. Natural sound was no exception.

Wright's quest to integrate exterior sound with the interior of the home is evident in the grammar

Figure 9. Living Room,
Avery Coonley House,
Riverside, IL (1908), The
Frank Lloyd Wright
Foundation
#0803.0022 (The
Museum of Modern Art
| Avery Architectural &
Fine Arts Library,
Columbia University,
New York).



of the Prairie House where rows of casement windows, protected by wide eaves, swing open more generously than conventional sash windows to admit, or close out, natural sounds and fresh air. Whether cross-axial, T-shaped or L-shaped, the axes of Prairie house plans were given an enhanced outward directional thrust through horizontal mouldings, horizontally-raked roman brick courses and the telescoping of spatial extremities along the outwardly-directed axes. Integral porches are common in Wright's houses (see [Figs. 1a, 1b](#)) but he was not averse to cantilevering some clients'

buildings (the Horner, Gale, and Affleck houses) out into space at the tree canopy level. This occurs most spectacularly at Fallingwater, where the major cantilevers project upstream, downstream and across Bear Run.

Pools and fountains were located within or adjacent to many houses. At the second Jacobs House (1943) a small pool bisected by glass exists both inside and outside the house. Visitors to the Susan Dana House (1901) ascend a half-storey to the reception area where the sound of water pouring from Richard Bock's 'Moon Children' relief sculpture

into a hexagonal pool enhances the arrival experience. On special occasions visitors were treated to a chorus from the gallery (a full storey above the living hall) or music from the Cecilian organ on a balcony opposite the gallery.⁴⁸ Along the entrance road to Taliesin visitors are greeted by the sound of the waterfalls at the dam that Wright constructed to generate electricity for his home. He subsequently redesigned the dam to incorporate a stepped stone pyramid that altered the sound of the falls.⁴⁹ Further on, near the principal entrance to Taliesin, a rectangular stone trough for watering horses was converted so that the water spills into a lower stone basin. Three fountain features at Taliesin West bring the welcome sight and sound of water to the desert site.

A water feature is the centerpiece of the Harold Price, Sr, House (1955) in North Phoenix, Arizona, and represents a radically open solution to living in desert conditions. The house, a 5,000 square foot single-storey structure on a slightly elevated site, features a 17 feet-high central atrium that divides the living, dining and kitchen spaces from the bedroom wing. Square in plan, the atrium is constructed of fourteen reverse-tapered concrete block piers from which two-feet tall thin steel-pipe columns support the flat roof. Two thirds of the space between the columns can be closed off by pairs of decorated wooden shutters whilst the upper five feet are fully open to the exterior, making the atrium an entirely openable pavilion. At its centre, beneath a square opening to the sky, water bubbles up in a shallow bowl and overflows into a square basin. The Price atrium is similar in principal to the *malqaf* [windcatcher] in traditional Near

Eastern houses in that both systems depend upon the passage of air moving through the upper reaches of the house to evaporate the water in the fountain and cool the space. Wright may have known of the *malqaf* through personal connections that included apprentices from Egypt and his own visits to Egypt and Iraq.⁵⁰

Every commission, site and client represented an opportunity to Wright, but those offering moving water—now recognised as the most preferred sound in nature⁵¹—clearly stimulated his aural imagination. The Pew House on Lake Mendota, Wisconsin (1939) is designed so that its cantilevered living room and porch straddle a small stream that flows into the lake. The George and Mary Gerts Cottage (1902) in Whitehall, Michigan and the W. A. Glasner House project for Glencoe, IL (1905), both involved portions of the houses that would bridge a stream-bearing ravine.

For the Mrs. Clinton Walker House in Carmel, California (1948), Wright designed a hexagonally-planned living room on a rocky promontory protected from the Pacific surf by a masonry prow. The metal-framed windows of its five-faceted bay are arranged in three set-back tiers cantilevered over a masonry base forming a domestic metaphor for the bridge of a ship (figs 10a, 10b). The bottom tier of windows rests upon a wooden base-board containing vents that slide open or closed horizontally to regulate the sound of the surf (and vent the room).

The sound of moving water can also be regulated at Fallingwater, the Edgar Kaufmann House, on Bear Run, Pennsylvania (1937), through a hatch leading down to the stream. Among the numerous authors

Figure 10a. Window bay, Mrs. Clinton Walker House, Carmel, CA, 1948 (Photo author).



who have written about Fallingwater, two have addressed the relationship of the sound of the falls to the house: the differences in their respective approaches is a measure of the wondrous complexity of the building. Grant Hildebrand, an architect and historian, analyses Fallingwater in terms of primordial themes of prospect and refuge, and of the psychological theme of hazard. Regarding sound he noted 'It is a commonplace that the waterfall is

heard throughout; it is less commonly observed that its sound is muted by the masses of concrete that intervene between the waterfall and the living spaces ... with the consequence that the sound is heard throughout, but softly.'⁵²

Neil Levine's meditation on Fallingwater takes as its point of departure Wright's explanation for placing the house over the waterfall rather than in view of it—so that the Kaufmanns could enjoy listen-



ing to 'to the music of the stream'. Thus, he wrote, Wright 'privileged the aural over the visual and thereby gave precedence to the continual over the momentary'. Levine's observation that 'The dimension of time and its dependence on the sense of hearing play a crucial role in the experience of the house ...' provides an entrée into the innumerable ways that the bold projection of its concrete cantilevers allow Fallingwater to be a timeless participant in the life of its forest setting.⁵³

Discussion: The aural as a spatial concept, before science

Wright asserted his modernity in many ways throughout his life but most presciently in the closing pages of his 1901 essay 'The Art and Craft of the Machine'⁵⁴ in which, from the top of a great central Chicago office building, he composed an ecstatic paean to the industrial city as a 'monster leviathan'⁵⁵ replete with analogies to the human body ('flesh-like tissue', 'nerve ganglia' and

'the pulse of activity'⁵⁶) —a vivid expression of his excitement about the modernity of the spectacle.

Emily Thompson has defined modern sound as a science-based activity that began with Wallace Sabine's formula, advanced during the 1910s and 1920s with the invention of new tools for the measurement, recording and broadcasting of sound, and culminated with Radio City Music Hall where a 'powerful combination of architectural and electrical control over sound' resulted in 'a culmination of the modern soundscape'.⁵⁷ Yet when it came to the science of architectural acoustics that forms the core of Thompson's book, Wright was dismissive even after sixty years of practice and told his apprentices: 'Well, that's all I know about acoustics. It isn't much. But when they talk to you about the laws of acoustics just take it with a grain of salt. ... when it comes down to specifically controlling them by way of proportion and substance and arrangements, I don't think any of the specialists know very much about it.'⁵⁸ Wright's claim to a sound modernity was limited by his insistence on intuition and the necessity to adhere to small, intimate spaces. Ironically, when he exceeded these parameters for the 3,050 seat Grady Gammage Auditorium in Tempe, Arizona, Vernon O. Knudsen, celebrated successor to Wallace Sabine and co-founder of the American Acoustical Society, was called upon to correct Wright's design ... scientifically.⁵⁹

Why did Wright insist on solving acoustics intuitively, and why did he reject Twentieth-Century acoustical science and the method of calculating sound by the laws of physics? Based on the iterations taken in this essay, and the concepts elaborated

Figure 10b. Window bay detail, Mrs. Clinton Walker House, Carmel, CA, 1948 (Photo author).

within them, several possibilities present themselves: Wright's attitude towards science is indebted to his childhood immersion in the Transcendentalist thought of Ralph Waldo Emerson,⁶⁰ who venerated nature as a manifestation of God,⁶¹ and frequently questioned the value of science. Emerson wrote: 'Empirical science is apt to cloud the sight, and by the very knowledge of functions and processes to bereave the student of the manly contemplation of the whole.'⁶² Wright echoed Emerson with: 'Science can take anything apart, that's its office, but it can never put the thing together again to live, you see. Science can give life to nothing; science can only provide you with the constituent parts and to put them together again to live after its life has been taken is beyond not only science but even art.'⁶³

Wright's dismissive attitude is also a reflection of his admiration for Dankmar Adler, a cherished mentor who was the most esteemed acoustician in the United States before Sabine. Furthermore, by the 1950s Wright was aware of the troubled history of theatre and music hall acoustics that transpired during his years of practice despite the constant advance of scientific approaches.⁶⁴ Then there is Wright's penchant for small, intimate spaces in which sound is easier to control even as theatres and music venues such as Radio City Music Hall, with its 6,015 seats, were expanding in size.

Finally, Wright's dismissal of the science of acoustics is a manifestation of an absolute confidence in his ability to solve design problems intuitively that was reinforced, with the exception mentioned earlier, throughout his career by abundant positive critical acclaim.

Notes and references

1. Emily Thompson, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933* (Cambridge, Mass., The MIT Press, 2004). In 1895, at the request of Harvard's President Eliot, Sabine used a compressed air-driven organ pipe and a chronograph to measure the length of sound duration which varied according to the amount of absorptive material introduced into the room. Sabine determined that the product of the reverberation time multiplied by the total absorptivity of the room (x) is proportional to the volume of the room (y) and this—($x y = k$)—became known as Sabine's law.
2. He wrote: 'Fascinated by buildings, she [his mother] took ten full-page wood-engravings of old English cathedrals from "Old England", a pictorial to which the father had subscribed, had then framed simply in flat oak and hung them upon the walls of the room that was to be her son's.' Frank Lloyd Wright, *An Autobiography* (New York, Duell, Sloan and Pearce, 1943 edition), p. 11.
3. *Ibid.*, pp. 10–11.
4. *Ibid.*, p. 13.
5. *Ibid.*, pp. 421–22: Wright to Carl Sandburg, 'Carl, if my mother hadn't decided for me that I was to be an architect, I should have been a very great musician. It would have been my next choice. And since the mind required for greatness in either art is the same, I should have been ranked with Beethoven, I am sure.'
6. *Ibid.*, p. 422. See also *Frank Lloyd Wright: His Living Voice*, Bruce Brooks Pfeiffer, ed. (Fresno, CA, The Press at California State University, 1987), pp. 69–70: 'So when you listen to Beethoven you are listening to a builder. You are seeing him take a theme, a motif, and building with it. All sorts of imaginative differentiations and rhythms come out from his handling of that motif, and it is a source of continual admiration. You cannot help when you finish listening to a Beetho-

ven symphony, just knocking your head on the ground with admiration and respect for the way he can build.'

7. According to Joseph M. Siry, *The Chicago Auditorium Building: Adler and Sullivan's Architecture and the City* (Chicago, IL, University of Chicago Press, 2002), p. 236, Adler travelled to Europe in 1888 with Ferdinand Peck, the primary client for the Auditorium, and John Bairstow, a stage carpenter, and visited the Drury Lane Theatre in London, the Budapest Opera House, the Bayreuth Festspielhaus and other music venues. See also Roula Mouroudellis Geraniotus, 'German Design Influence in the Auditorium Theater', in John S. Garner, ed., *The Midwest in American Architecture* (Urbana and Chicago, IL, University of Illinois Press, 1991), pp. 43–75. It is likely, given the population of German immigrant architects in Chicago in the late nineteenth century, that Adler would have been familiar with the many articles that were being published in the *Deutsche Bauzeitung* during the 1880s when theatres and opera houses in Halle, Vienna, Frankfurt, Dresden, Berlin and other cities were being built or refurbished. Dankmar Adler, 'Theater Building for American Cities: First Paper', *Engineering Magazine*, 7 (August, 1894), pp. 717–730; the 'Second Paper' (September, 1894), pp. 815–829, cites the isacoustic curve of John Scott Russell as an inspiration for the banking of seating in the Auditorium Building but does not cite German or French publications pertaining to the acoustic design of theatres.
8. F. L. Wright, *An Autobiography*, op. cit., p. 21.
9. Wright's non-domestic commissions during the Prairie period include: Hillside Home School (1902), Larkin Administration Building (1903–6), Dwight Bank (1904–5), E-Z Polish Factory (1905), Frank Smith Bank (1905), Unity Temple (1905–8), River Forest Country Club (1906), Larkin Company Exhibition Building and Theater (1907), City Bank and Hotel (1909) and the Stohr Arcade (1909), as well as six resort and recreational buildings and six unrealised non-domestic projects.
10. For an account of Wright's life between 1909 and 1930, see, Robert C. Twombly, *Frank Lloyd Wright: His Life and His Architecture* (New York, John Wiley & Sons, 1979), pp. 119–210.
11. See, Frank Lloyd Wright, Bruce Brooks Pfeiffer, ed., *The Letters Trilogy: Letters to Apprentices, Letters to Architects, Letters to Clients* (Fresno, CA, California State University Fresno, 1986; 2nd ed.), *Letters to Apprentices*, pp. 28, 77.
12. Wright describes taking part in an orchestra that his father assembled in Madison in *An Autobiography*, op. cit., p. 33, and his own family orchestra in Oak Park, in which each of the six children played an instrument and Catherine sang, in *An Autobiography*, op. cit., p. 116.
13. According to 'My Method of Composing Music, by Olgivanna Lloyd Wright', in, Maxine Fawcett-Yeske, Bruce Brooks Pfeiffer, compilers and editors, *The Life of Olgivanna Lloyd Wright* (Novato, CA, Oro Editions, 2017), pp. 281–2, Mrs. Wright drew upon music sources from her life in Montenegro, Serbia and the Caucasus, and her years of study under the mystic, philosopher and composer George Gurdjieff at his Institute for the Harmonious Development of Man in Prieuré des Basses Loges near Fontainebleau. She wrote that 'From 1954 to 1960 I composed over 100 works for piano as well as various orchestral scores for the dance, sonatas, trios, preludes, a prologue and suite for violin, and orchestral suites.'
14. Frank Lloyd Wright, *The Taliesin Prospectus* (published by the Taliesin Fellowship, December, 1933) in Bruce Brooks Pfeiffer, ed., *Frank Lloyd Wright: Collected Writings, vol. 3, 1931–1939* (New York, Rizzoli International Publications, Inc., in association with The Frank Lloyd Wright Foundation, 1993), p. 165.

15. Randolph C. Henning, ed., *'At Taliesin' Newspaper Columns by Frank Lloyd Wright and the Taliesin Fellowship 1934–1937* (Carbondale & Edwardsville, IL, Southern Illinois University Press, 1992), p. 78.
16. Louis Sullivan, 'Development of Construction', *Economist*, 55 (24th June, 1916), p. 1252. See also Roula Mouroudellis Geraniotis, 'German design influence in the auditorium theater', in, Walter L. Creese, John S. Garner, *The Midwest in American architecture* (Urbana, IL, University of Illinois Press, 1991), p. 65: she notes that Louis Sullivan 'owned lavish monographs on the Imperial Opera House in Vienna and the Opera House in Frankfurt'.
17. F. L. Wright, *An Autobiography*, *op. cit.*, p. 107.
18. FLLW Reel #18A April 1, 1951, transcribed 'Acoustics' (The Frank Lloyd Wright Foundation Archives, The Museum of Modern Art/Avery Architectural and Fine Arts Library, Columbia University, New York), pp. 1–13.
19. *Ibid.*, p. 5.
20. *Ibid.*, p. 7.
21. F. L. Wright, *An Autobiography*, *op. cit.*, p. 30: 'There would be the *Eisteddfod* [a traditional Welsh festival of literature, music and performance] then and there. His son [Wright], the "modern" note, would give "Darius Green and his Flying Machine" or "Wonderful One Hoss Shay". But the hymn-singing—in unison of course—was the most satisfying feature of the day, unless it was Uncle Jenkin's preaching. All would join in, tears—under those circumstances—reaching their best.'
22. See, Joseph M. Siry, 'Modern Architecture for Dramatic Art: Frank Lloyd Wright's "New Theatre", 1931–2009', *The Art Bulletin* (April, 2014): he cites a letter from Bea Handel to Waldo Stewart (November 6, 1959, box 177, folder 2, Dallas Theatre Company Archives) in which Wright is quoted: 'If the people on your board are worried about me not coming they need not for I wanted to be an actor when I was young and I became busy in other things. I do not have a theater in the world which I have designed. Yes, indeed I will be there.'
23. Edgar Kaufmann, Ben Raeburn, eds, *Frank Lloyd Wright: Writings and Buildings* (New York, Horizon Press, 1960), pp. 302–303: 'Shakespeare was in my pocket for the many years I rode the morning train to Chicago.'
24. J. M. Siry, 'Modern Architecture for Dramatic Art', *op. cit.*, p. 219.
25. *Ibid.*
26. *Ibid.*, p. 230.
27. F. L. Wright, *An Autobiography*, *op. cit.*, p. 116: 'To each child, early in his life, I gave a musical instrument. To learn to play it well was all I asked of their education. ... Their mother played piano, reading. I played the piano a little myself, trying to improvise, letting the piano play itself.' The eldest child, Lloyd, conducted with his cello bow and rapped the skull of the player of a wrong note with the result that 'The howls and wails that mingled with the music gave a distinctly modern effect to every performance.'
28. These are the Hillside Theatre at Taliesin, constructed in 1933, burned and reconstructed in 1952, and the Kiva (1937), Cabaret (1949) and Music Pavilion (1956) at Taliesin West.
29. For *Two Chicago Architects and Their Clients: Frank Lloyd Wright and Howard Van Doren Shaw* (Cambridge, Mass., The MIT Press, 1969), Leonard K. Eaton submitted a questionnaire to 86 clients of Wright and 92 clients of Shaw (or their representatives). Under the category of 'Participation in the Arts—a Musician', eleven Wright clients registered themselves as musicians as opposed to none for the conservative Shaw. The weekly showing of 'Art house' films at the Hillside Theatre was open to the public—another way of enticing clients.

30. FLLW Reel #18A April 1, 1951, transcribed 'Acoustics', *op. cit.*, p. 5.
31. According to Bruce Brooks Pfeiffer, *Frank Lloyd Wright Monograph 1951–1959* (Tokyo, A.D.A. Edita, 1988), p. 62, the seating of Wright's Hillside Theatre #2 'is planned on the reflex, rather than *en face*. He maintained that any performance was more pleasant to behold from the $\frac{3}{4}$ angle than from head on, just as the human face reveals its character in this way of seeing it.'
32. F. L. Wright, *An Autobiography*, *op. cit.*, p. 470.
33. The Cabaret replaced the Kiva (1939), a small 23' x 30' desert masonry building that served as a theatre accommodating approximately 30 people.
34. Wright's desert masonry consisted of faceted volcanic boulders found on and near the site that were usually arranged flat-side out within wooden forms and solidified as masonry walls with a mixture of dry concrete and small rounded filler stones. Most of the walls at Taliesin West were battered and under compression but Wright's decision to make the Cabaret ceiling/roof of desert masonry under tension was a risky experiment that led to the need for additional support.
35. Curtis Besinger, *Working with Mr. Wright: What It Was Like* (Cambridge, Cambridge University Press, 1995), p. 208.
36. *Ibid.*, p. 209.
37. FLLW Reel #18A April 1, 1951, transcribed 'Acoustics', *op. cit.*, p. 5.
38. *Ibid.*, p. 8.
39. As E. Thompson demonstrates in chapters 4, 'Noise and Modern Culture, 1900–1933' and 5, 'Acoustical Material and Modern Architecture, 1900–1933', of *The Soundscape of Modernity*, *op. cit.*, a plenitude of new machines increased the level of noise, particularly in urban areas, which in turn lead to the creation of new materials for noise abatement in offices and urban flats.
40. See Vincent J. Scully, Jr, *The Shingle Style and the Stick Style* (New Haven, London, Yale University Press, 1973) for illustrations of coastal summer homes by McKim, Mead, & White, Wilson Eyre, Lamb and Rich, and others in the 1880s, that feature large living halls and broad openings between the principal living spaces of the main floor.
41. From R. C. Henning, ed., 'At Taliesin', *op. cit.*, p. 80.
42. A client, Betty Van Orden (formerly Mrs. Stuart Richardson), interviewed by Indira Berndtson on 22nd January, 1995, said: 'That was one of the interesting things about that living room, ... that we could have all of the apprentices—and there were a lot of them ... twenty or thirty—and the quartet and the maestro and Olgivanna or Madame—and it wasn't crowded. And yet the evening that the four of us sat in front of the fireplace there, it didn't feel bare.'
43. Michael Forsyth, *Buildings for Music: The Architect, the Musician, and the Listener from the Seventeenth Century to the Present Day* (Cambridge, Mass., The MIT Press, 1985), p. 156.
44. Theodore Lyman, ed., *Collected Papers on Acoustics by Wallace Clement Sabine* (Cambridge, Mass., Harvard University Press, 1922), p. 137. Further support for Wright's belief in the efficacy of applied mouldings as a deterrent to excessive sound reflection can be found in, Barry Blesser, Linda-Ruth Salter, *Spaces Speak, Are You Listening?* (Cambridge, Mass., The MIT Press, 2007), pp. 58–59: 'As the aural analogue of wallpaper, consider a wall that had a pattern of conch shells embedded in it, thus creating a pattern of resonances at different frequencies—like variations in aural color. Such a wall would have aural texture. By standing at the optimum distance, you would hear the texture.'
45. Grant C. Manson, *Frank Lloyd Wright to 1910: The First Golden Age* (New York, John Wiley and Sons, 1958), p. 187.

46. Dean Eastman to the Author, e-mail 27th November, 2014; the message continues, 'I believe the many sloped planes of the ceiling with varying heights as well as the stiff and heavy ceiling and floor play an important role. The Dining room acoustics are also very good.' See also, Dean Eastman, *Frank Lloyd Wright's Coonley House: An Unabridged Documentary* (published by Dean Eastman, 2014).
47. Grant Hildebrand, *Frank Lloyd Wright's Palmer House* (Seattle, London, University of Washington Press, 2007), pp. 103–107.
48. Mark Heyman, 'Wright and Dana: Architect and Client', in, Mark Heyman, Richard Taylor, *Frank Lloyd Wright and Susan Lawrence Dana: Two Lectures* (Springfield, IL, Sangamon State University, 1985), p. 30. Donald P. Hallmark, 'Dana-Thomas House: Its History, Acquisition, and Preservation', *Illinois Historical Journal*, Vol. 82, No. 2 (Summer, 1989), pp. 115–6, states that 'Susan's interest in music is as well documented as Wright's. Seventy-seven of her original player organ rolls exist, evenly divided between the popular music of the day (circa 1905–1910) and classical selections, particularly the works of Schubert and Beethoven. ... She frequently hosted benefit musical concerts, in the gallery and the Springfield newspapers reported regularly on her parties and receptions. Given the architect's love of music and his client's request that the Dana House have several musicians' balconies, it is no wonder that each room has a design development of its own that could serve as a music area. Taken all together, the Dana House reflects its owner's style in that it is a rich and complex symphony of architectural notes and lyrical melodies.'
49. Author's conversation with Liz Phillips, a professional sound artist based in New York. According to e-mail from Keiran Murphy, Taliesin Preservation Inc., to the Author, 1st February, 2018, a photograph from the Wisconsin Department of Natural Resources, of 13th January, 1946, shows the dam with the current pyramidal configuration.
50. Wright was drawn to the Arab world as a child from reading *One thousand and One Nights*, which he passed on to his children in the form of 'The Fisherman and the Genie' mural in their Oak Park playroom. Wright's first documented architectural connection to Egypt, in 1927, came in a commission for six seasonal tents at Raz-el-Bar, a Mediterranean beach town along the Dumyât branch of the Nile. Among several Egyptian apprentices who joined Taliesin prior to 1955, Kamal Amin left architecture school in Cairo to join the Taliesin Fellowship in 1951. Wright's Baghdad, Iraq, commission, enabled him to visit Cairo in May, 1957, according to Cairoobserver.com. of 18th January, 2014.
51. Jian Kang, 'Soundscape and Movement', in, Peter Blundell Jones, Mark Meagher, eds, *Architecture and Movement: The Dynamic Experience of Buildings and Landscapes* (London and New York, Routledge Press, 2105), p. 124.
52. Grant Hildebrand, *The Wright Space: Pattern & Meaning in Frank Lloyd Wright's Houses* (University of Washington Press, Seattle, 1991), p. 104.
53. Neil A. Levine, 'To Hear Fallingwater is to See It in Time', in, Lynda Waggoner, ed., *Fallingwater* (New York, Rizzoli International Publications, Inc., 2011), pp. 189–213.
54. F. L. Wright, 'The Art and Craft of the Machine', in, Edgar Kaufmann, Ben Raeburn, eds, *Frank Lloyd Wright: Writings and Buildings* (New York, Horizon Press, 1960), pp. 55–73.
55. *Ibid.*, p. 72.
56. *Ibid.*, pp. 72, 73.
57. E. Thompson, *The Soundscape of Modernity*, *op. cit.*, p. 233.
58. FLLW Reel #18A April 1, 1951, transcribed 'Acoustics', *op. cit.*, p. 9. Wright's discussion of acoustics with his apprentices depended heavily upon what he learned

from D. Adler, much of which is available in Adler's 'Theater Building for American Cities: First Paper', *op. cit.* Wright's innovations build upon Adler's: he preferred a small 'house' to a large one, he advocated 'hearing and listening as acute and perfect, as possible. Sight is the same. ... And one thing that I substituted for his [Adler's] trumpet was the flat overhead ceiling with nothing touching it all around—timpanum, like a drum. Over the audience and over the stage, alike—that works beautifully—and it works here [in the Cabaret]. ... One level ceiling over performers and audience. Now the quality of that ceiling can be made anything—you can almost tune it like putting tension on the head of a drum. But you've got to keep all reactions away from it—see, I carried it over and left the wall free of this timpanum overhead.' Wright then cites 'the gash beside the piano'—an opening in the west wall at the stage level for storage but which also enhanced the resonance of the piano once it was moved onto the stage. See also J. M. Siry, 'Modern Architecture for Dramatic Art', *op. cit.*, pp. 213–237.

59. Joseph M. Siry, 'Wright's Baghdad Opera House and Gammage Auditorium: In Search of Regional Modernity', *Art Bulletin*, 87 (June, 2005), p. 289 (or pp. 265–311).
60. Wright's sister, Maginel Wright Barney, reveals something of the status Emerson held in her family in *The Valley of the God-Almighty Joneses* (New York, Apple-

ton-Century, 1965), p. 59: 'Most impressive was the gleaming square piano at the end of the room. My brother always claimed it was a Steinway, but I know very well that it was an Emerson, because I remember the awe and admiration I felt, believing a man of that name could build pianos and write books, too—books that one's mother, father, aunts, and uncles were always quoting: "As Mr. Emerson says ... "'

61. 'A man should carry nature in his head.': Ralph Waldo Emerson, 'Concord Walks', *The Complete Works of Ralph Waldo Emerson* (1904), vol. 12, 'Natural History of Intellect and Other Papers', paragraph 11 (Bartleby.com Great Books Online).
62. Brooks Atkinson, ed., *The Complete Essays and Other Writings of Ralph Waldo Emerson* (New York, Random House, Inc., 1950), p. 36. Emerson also stated, p. 37: 'A dream may let us deeper into the secret of nature than a hundred concerted experiments.'
63. Bruce Brooks Pfeiffer, *Frank Lloyd Wright: His Living Voice*, *op. cit.*, p. 87.
64. These include Orchestra Hall, Chicago (1904), the Eastman Theatre, Rochester, NY (1923), Severance Hall, Cleveland, Ohio (1931) and the Royal Festival Hall, London (1951). Regarding Severance Hall and the Eastman Theatre, see Leo Beranek, *Concert Halls and Opera Houses: Music, Acoustics, and Architecture* (New York, Springer Verlag, 2004; second ed.), pp. 61, 129.