

# Hearing Architecture

A FRAGMENT OF

*EXPERIENCING ARCHITECTURE* (1959)

by Steen Eiler Rasmussen

Can architecture be heard? Most people would probably say that as architecture does not produce sound, it cannot be heard. But neither does it radiate light and yet it can be seen. We see the light it reflects and thereby gain an impression of form and material. In the same way we hear the sounds it reflects and they, too, give us an impression of form and material. Differently shaped rooms and different materials reverberate differently.

We are seldom aware of how much we can hear. We receive a total impression of the thing we are looking at and give no thought to the various senses that have contributed to that impression. For instance, when we say of a room that it is cold and formal, we seldom mean that the temperature in it is low. The reaction probably arises from a natural antipathy to forms and materials found in the room—in other words, something we *feel*. Or it may be that the colors are cold, in which case it is something we *see*. Or, finally, it may be that the acoustics are hard so that sound—especially high tones—reverberate in it; something we *hear*. If the same room were given warm colors or furnished with rugs and draperies to soften the acoustics, we would probably find it warm and cozy even though the temperature was the same as before.

If we think it over, we shall find that there are a number of structures we have experienced acoustically. From my own childhood I remember the barrel-vaulted passage leading to Copenhagen's old citadel. When the soldiers marched through with fife and drums the effect was terrific. A wagon rumbling through sounded like thunder. Even a small boy could fill it with a tremendous and fascinating din—when the sentry was out of sight.

These early memories bring to mind the tunnel noises in the motion picture *The Third Man*. While the greater part of this picture is composed as a sort of collage of movie scenes and zither music which

bears no relation to the action, the final scenes are entirely without music and give a very realistic visual and oral impression of a gangster hunt through the endless underground tunnels of Vienna's sewer system. The characteristic sounds which tunnels produce are clearly heard in the splashing of the water and the echoes of the men hunting the third man. Here, architecture is certainly heard. Your ear receives the impact of both the length and the cylindrical form of the tunnel.

Thorvaldsen's Museum in Copenhagen has an acoustical effect very much like that of passageways and tunnels. In 1834 the Danish king donated an old barrel-vaulted coach house to hold the works of the famous sculptor. The building was converted into a beautiful museum with one statue in each barrel-vaulted room, where the long echoes of the coach-house still seem to linger. It is a house for stone effigies and has none of the comforts of houses built for human beings. The floors are of stone, the walls of stone, the ceilings of stone, even the residents are of stone. All of these hard, sound-reflecting surfaces give the rooms their hard, long-reverberating tones. When you enter this home of statues you are in a world that is very different from the rather provincial little capital of the nineteenth century which built it. It is more like Rome, great and dignified as the vaulted ruins of Antiquity or the stone corridors of the grandiose palazzos from which ease and comfort were debarred.

The energetic director of the museum employs many methods of attracting visitors, including music recitals among the works of art. The entrance hall is one of the noblest rooms in Copenhagen but certainly not designed for chamber music. It is necessary to convert the acoustics completely for these musical events by covering the floor with matting and hanging fabrics on the walls. Then, if the audience is large enough to compensate for the lack of upholstery in the austere hall the room changes its manners, gives up its stentorian voice and becomes so civilized that it is possible to distinguish every tone of each instrument.

This may lead to the opinion that the acoustics of Thorvaldsen's Museum are poor unless steps are taken to improve them—which is true enough when it is used for chamber music. But it could just as well be said that it has excellent acoustics, provided the right kind of music is performed. And such music exists. The chants that were created for the Early Christian church in Rome would sound very well in the stone hall of Thorvaldsen's Museum. The old basilicas were not vaulted but they had the same hard character with their mosaic floors, naked walls and marble columns. And they were so huge and empty that sound continued to reverberate in them back and forth between the massive walls. The greatest church of early Christendom was the Basilica of St. Peter, forerunner of the present Renaissance edifice in Rome. It was an enormous, five-aisled building with stone columns separating the aisles. In

*Planning for Good Acoustics* Hope Bagenal explains why the acoustical conditions of such a church must by their very nature lead to a definite kind of music. When the priest wished to address the congregation he could not use his ordinary speaking voice. If it were powerful enough to be heard throughout the church, each syllable would reverberate for so long that an overlapping of whole words would occur and the sermon would become a confused and meaningless jumble. It therefore became necessary to employ a more rhythmic manner of speaking, to recite or intone. In large churches with a marked reverberation there is frequently what is termed a "sympathetic note"—that is to say "a region of pitch in which tone is apparently reinforced." If the reciting note of the priest was close to the "sympathetic note" of the church—and Hope Bagenal tells us that probably both of them were, then as now, somewhere near A or A flat—the sonorous Latin vowels would be carried full-toned to the entire congregation. A Latin prayer or one of the psalms from the Old Testament could be intoned in a slow and solemn rhythm, carefully adjusted to the time of reverberation.

#### I AM SITTING IN A ROOM

for voice and electromagnetic tape (1970)

by Alvin Lucier

#### Necessary Equipment:

one microphone, two tape recorders, amplifier and one loudspeaker.

Choose a room the musical qualities of which you would like to evoke.

Attach the microphone to the input of tape recorder #1.

To the output of tape recorder #2 attach the amplifier and loudspeaker.

Use the following text or any other text of any length:

I am sitting in a room different from the one you are in now.

I am recording the sound of my speaking voice and I am going to play it back into the room again and again until the resonant frequencies of the room reinforce themselves so that any semblance of my speech, with perhaps the exception of rhythm, is destroyed.

What you will hear, then, are the natural resonant frequencies of the room articulated by speech.

The priest began on the reciting note and then let his voice fall away in a cadence, going up and down so that the main syllables were distinctly heard and then died away while the others followed them as modulations. In this way the confusion caused by overlapping was eliminated. The text became a song which lived in the church and in a soul-stirring manner turned the great edifice into a musical experience. Such, for instance, are the Gregorian chants which were especially composed for the old basilica of St. Peter in Rome.

When this unison religious music heard on a gramophone record that was recorded in a studio with a comparatively short reverberation, is sounds rather poor. For, though too much overlapping causes confusion, a certain amount is necessary for good tone. Without it, choral music, especially, sounds dead. But when the same record is played in a room with long reverberations, the tone becomes much richer. The keynote is heard almost the entire time, gradually filling out and then withdrawing, and together with it the others are heard as intervals of

I regard this activity not so much as a demonstration of a physical fact, but more as a way to smooth out any irregularities my speech might have.

Record your voice on tape through the microphone attached to tape recorder #1.

Rewind the tape to its beginning, transfer it to tape recorder #2, play it back into the room through the loudspeaker and record a second generation of the original recorded statement through the microphone attached to tape recorder #1.

Rewind the second generation to its beginning and splice it onto the end of the original recorded statement on tape recorder #2.

Play the second generation only back into the room through the loudspeaker and record a third generation of the original recorded statement through the microphone attached to tape recorder #1. Continue this process through many generations.

All the generations spliced together in chronological order make a tape composition the length of which is determined by the length of the original statement and the number of generations recorded.

Make versions in which one recorded statement is recycled through many rooms.

Make versions using one or more speakers of different languages in different rooms.

Make versions in which, for each generation, the microphone is moved to different parts of the room or rooms.

Make versions that can be performed in real time.

a third or a fifth, so that the coinciding of notes produces a harmony as in part-singing. Thus, in the old churches the walls were in fact powerful instruments which the ancients learned to play upon.

When it was discovered that the unifying tonal effect of the church as an instrument was so great that more than one tone could be heard at the same time with pleasing results, the harmonies produced by the coinciding of notes began to be regulated and used. From this part-singing developed. "Polyphonic music, as heard today in Westminster Cathedral," says Hope Bagenal, "was directly produced by a building form and by the open vowels of the Latin language..."

Vaults, and more especially domed vaults, are acoustically very effective. A dome may be a strong reverberator and create special sound centers. The Byzantine church of St. Mark's, in Venice, is built over a Greek cross in plan and has five domes, one in the center and one over each of the four arms of the cross. This combination produces very unusual acoustical conditions. The organist and composer Giovanni Gabrieli, who lived around 1600, took advantage of them in the music he composed for the cathedral. St. Mark's had two music galleries, one to the right and one to the left, as far from each other as possible and each with its dome as a mighty resonator. The music was heard from both sides, one answering the other in a *Sonata Pian e Forte*. The congregation not only heard two orchestras, it heard two domed rooms, one speaking with silver tones, the other responding in resounding brass.

Though this is a unique example, every large church interior has its own voice, its special possibilities. Hope Bagenal has convincingly demonstrated the influence of the historical types of church on schools of music and declamation. After the Reformation, changes affecting church acoustics had to be made in order to adapt the edifices for the new religion in which preaching in the native language played so important a role. Bagenal's analysis of the St. Thomas church at Leipzig, where Johan Sebastian Bach was the organist, is particularly interesting. Much of Bach's music was composed especially for that church. It is a large, three-aisled Gothic edifice with level vaults. After the Reformation large areas of resonant wood were added to the naked stone. The wood absorbed a great deal of sound and greatly reduced the period of reverberation. The side walls were lined with tiers of wooden galleries and numerous private boxes, or "swallow's nests," as they were called. The encroachment of so many boxes and galleries was due to the Lutheran system of church government which placed the church under the town council. Each member had his own family loge or box, just as one might at the opera. The new additions were in the Baroque style, with richly carved moldings and panels, and there were curtains at the openings. Today, when the fixed rows of chairs

on the floor and the gallery pews and boxes are filled, as they always are when Bach concerts are held, the congregation numbers about 1800. All this wood helped to create the acoustics that made possible the seventeenth century development of Cantata and Passion. Hope Bagenal figures the present reverberation at  $2\frac{1}{2}$  seconds as compared to from 6 to 8 seconds in the medieval church. The absence of a "note" or region of response in the church made it possible for Bach to write his works in a variety of keys.

These new conditions made possible a much more complicated music than could ever have been enjoyed in the early church. Bach's fugues, with their many contrapuntal harmonies, which would be lost in vast basilicas, could be successfully performed in St. Thomas', just as the pure voices of the famous St. Thomas boys' choir receive full justice there.

St. Thomas Church, acoustically speaking, stands between the Early Christian church and the eighteenth-century theater. In the latter, where tiers of loges or boxes covered the walls from floor to ceiling, there was even more sound absorption. The façades of the boxes were richly carved and the boxes themselves draped and upholstered. At each performance the floor was closely packed with a gala-clad audience. The ceiling was flat and relatively low so that it acted as a sounding-board, deflecting the tones in towards the boxes where they were absorbed by all the woodwork and upholstery. As a result, the reverberation was very short and every note—even in such florid musical ornaments as coloratura and pizzicato—could be distinctly heard.

In Copenhagen, in 1748, Nicolai Eigtved built the "Danish Comedy House" with an auditorium in the shape of a horseshoe and three tiers of boxes. In 1754 he designed a flat-roofed church for Christianshavn, just across the harbor from Copenhagen, in which galleries on three sides were formed almost like boxes in the theater. The entire interior was very foreign to any previous church tradition. Instead of sitting in a semi-dark nave from where the devout congregation would follow the ceremony at the distant altar as something mystic and remote, the worshippers here sat in the almost dazzling effulgence of the church of Rationalism, comfortably near the altar and pulpit. They were connected with, rather than separated from, the sacred ceremonies of their faith. It was a church in which the sermon was of major importance. Here, the preacher could really let himself go. If members of the congregation felt that his exhortation was too long-winded—and sermons could be very long at the end of the eighteenth century—they could close the windows in their pews and shut out all sound. This type of church was by no means unusual at the time. In Copenhagen alone four churches of similar type appeared during this period.

The Rococo period, which so radically created a new type of church to meet the requirements of a new age, also produced great town houses with interiors that were much more comfortable than those of the mansions of the Baroque period. The rooms in the new houses varied not only in size and shape but also in acoustical effect. From the covered carriage entrance the visitor came into a marble hall which resounded with the rattle of his sidearms and the clatter of his high heels as he followed the *major domo* across the stone floor and entered the door held open for him. Now came a series of rooms with more intimate and musical tones—a large dining room acoustically adapted for table music, a salon with silk- or damask-paneled walls which absorbed sound and shortened reverberations, and wooden dadoes which gave the right resonance for chamber music. Next came a smaller room in which the fragile tones of a spinet might be enjoyed and, finally, madame's boudoir, like a satin-lined jewelry box, where intimate friends could converse together, whispering the latest scandals to each other.

The Classic and Gothic revivals of the late eighteenth and early nineteenth centuries led inevitably to eclecticism in architecture in which creative design gave way to the accurate copying of details. Much that had been gained during the past centuries was first ignored and then forgotten. There was no longer any personal conception behind the rooms the architect planned and therefore he gave as little thought to their acoustic function and acoustical effect as to the texture of the materials he used. The exteriors of new churches were correct copies of Classic or Gothic prototypes but the interiors were not designed for definite types of oratory or music. In new theaters the flat ceilings of earlier days were discarded for slightly domed ceilings which produced acoustical conditions the architects could not master. Indifference to textural effects led to indifference to sound absorption. Even concert halls were designed quite casually, but as the programs they offered included every kind of music, with no regard for their special acoustical requirements, this was less important than it might have been. The height of confusion in this sense, however, came with the modern "talkies," in which you could see and hear the wide open prairie thundering under the hooves of galloping horses and at the same time listen to a symphonic orchestra playing romantic music à la Tchaikovsky—every possible banal effect served up in the same picture.

Radio transmission created new interest in acoustical problems. Architects began to study acoustical laws and learned how a room's resonance could be changed—especially how to absorb sound and shorten the period of reverberation. Too much interest has been given to these easily attained effects. The favorite interior of today seems to be something so unnatural as a room with one wall entirely of glass and the

other three smooth, hard and shiny and at the same time with a resonance that has been so artificially subdued that, acoustically speaking, one might just as well be in a plush-lined mid-Victorian interior. There is no longer any interest in producing rooms with differentiated acoustical effects—they all sound alike. Yet the ordinary human being still enjoys variety, including variety of sound. For instance, a man tends to whistle or sing when he enters the bathroom in the morning. Though the room is small in volume, its tiled floor and walls, porcelain basin and water-filled tub, all reflect sound and reinforce certain tones so that he is stimulated by the resonance of his voice and imagines himself a new Caruso. What a flat feeling it gives when you come into a bathroom that has been given the favorite modern acoustical treatment which has the very one-sided aim of smothering all such cheerful noises. MIT's Faculty Club has one of the most perfectly equipped lavatories in the world. You enter it happily for a refreshing wash before lunch. A benefactor donated so much magnificent marble that it glistens with hard elegance and you say to yourself: "Here my voice is going to ring out marvelously." But the first joyous note from your lips falls as flat and muffled on your ear as it would in a heavily upholstered living-room. To put the finishing touch on this perfect marble washroom, the architect has given the ceiling the most sound-absorbing surface it is possible to attain!

I hope that I have been able to convince the reader that it is possible to speak of *hearing architecture*. Though it may be objected that, at any rate, you cannot hear whether or not it is good architecture, I can only say that neither is it certain you can *see* whether it is good or not. You can both see and hear if a building has character, or what I like to call *poise*. But the man has not yet been found who can pass judgment, logically substantiated, on a building's architectural value.

The only result of trying to judge architecture as you would a school paper—A for that building, B for that one, etc.—is to spoil the pleasure architecture gives. It is a risky business. It is quite impossible to set up absolute rules and criteria for evaluating architecture because every worthwhile building—like all works of art—has its own standard. If we contemplate it in a carping spirit, with a know-it-all attitude, it will shut itself up and have nothing to say to us. But if we ourselves are open to impressions and sympathetically inclined, it will open up and reveal its true essence. It is possible to get as much pleasure from architecture as the nature lover does from plants. He cannot say whether he prefers the desert cactus or the swamp lily. Each of them may be absolutely right in its own locality and own clime. He loves all growing things, familiarizes himself with their special attributes and therefore

knows whether or not he has before him a harmoniously developed example or a stunted growth of that particular variety. In the same way we should experience architecture.