Art as Integral Part of Architectural Space

by

Marta Vahtar
M.S.Arch., 1991, School of Architecture and Civil Engineering
B.S.Land.Arch, 1987, Biotechnical Faculty
University of Ljubljana, Slovenia

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Signature of Author . . . .
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Certified by . . . .
Otto Piene, Director, Center for Advanced Visual Studies
Thesis Advisor

Accepted by . . . .
Otto Piene
Departmental Committee on Graduate Studies

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ABSTRACT

To integrate art with architecture is the intention of every architect. However, many times other requirements overwhelm artistic potential. There are numerous good, simple examples in the history of architecture where solutions to a variety of often functional requirements have
produced exceptional artistic expressions, which in turn have inspired contemporary architectural practice. Pre-industrial architecture not only responded to natural conditions in the environment; it employed all the senses as well in its design of living environments. Today, unfortunately, we rarely find that architects pay attention to sound, smell, water, natural cycles, or, almost unimaginable, to time. Our technology encourages us to separate ourselves from nature. However, this same technology can help us to reintegrate ourselves with nature by designing better living environments. This thesis is, therefore, my way of rethinking design principles that shape the contemporary urban environment and often give it such a cold, formal image.

My own philosophy of design is given in the introduction. The rest of the thesis is basically the supportive material, which further illuminates the ideas presented in the introduction. The first part discusses some general trends in contemporary society in order to place my own view of design within a broader context, while the second part lists numerous examples from the history of architecture and art to illustrate and further my philosophy. At the end, in the appendix, I present one of my own projects, the *Interactive Water Curtain*, to concretely show some of the implications of my aesthetics.

Through this work I hope to illustrate the richness of various traditional architectural practices that take advantage of sound, water, time (celestial movement), fragrances, and even living creatures in designing places. I hope this will stimulate creative thinking about using not just visual effects in the design of our living environment, but employing acoustic, olfactory, astronomical, ecological, and kinesthetic design in order to create sensually richer and more pleasant environments where people can live in harmony with nature and other living creatures.

Thesis Supervisor: Otto Piene, Professor of Visual Studies

PREFACE

My parents, taking me on long walks in the woods or in the mountains, taught me to appreciate nature and natural phenomena early on. Showing me things that one can learn only from nature, they considerably influenced the way I perceive environments today. Latter, as a student of landscape architecture and architecture, I became interested in how to make people see and appreciate what is so important to me: to feel, to see, to hear, to smell, to touch, to understand, to be erraptured with the small, simple things around us again and again, to live. In many regards, staying at MIT broadened my perspective, and the Center for Advanced Visual Studies definitely expanded my understanding of what art can be all about.

Interested in creating architecture that fully responds to the natural environment and provides a more pleasant and sensually rich environment, I am trying to rethink design principles that shape urban environments today. This thesis is a part of this ongoing process. There are many people who influenced my thinking and helped contribute to my work. Among those are my advisor Professor Otto Piene, who taught me that there is no limit to the human imagination, and my thesis readers Professor Paul Earls, Joan Bringham, and Professor Dennis Frenchman, each of whom expanded my thinking in a different direction. I also have to mention Professor John Beardsley from GSD at Harvard, who provided me with much valuable information, and many artists whom I met at the CAVS and who helped me with numerous suggestions. Those are Christopher Janney, John Powell, Keiko Prince, and David Larkin, to mention just a few.

Among those who helped me with the development of the prototype for the *Interactive Water Curtain*, I would especially like to thank Marjan Jenko from Microelectronics Research Lab at Boston University, who helped me with the electronics; Professor Dennis Thurmond, head of the Music Synthesis Lab at Berklee College of Music, who helped me with the musical part; Professor Dick Fenner, the manager of the Fluid Mechanics Lab at MIT, who answered all my water-related questions; Christopher Janney, who expanded my view on possibilities for human interaction with the fountain; and John Powell, who helped me whenever I got stuck.

At the end I would like to thank the people from the Writing Center at MIT, as well as many friends, especially Caryn Johnson, who helped me edit the manuscript.

The world is a beautiful book,
but of little use to him who cannot read it.
Pamela Goldoni

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Going down the main corridor, I walked along the new water curtain, an unusual water fountain that attracted much local attention. I hadn't seen it yet, so I was curious to find out how it looked. But it didn't seem to be working. Everything was quiet. I just heard water drops from time to time. Then I noticed a rainbow on the ceiling; a water prism was splitting the white light into a rainbow. I started to walk along the curtain and, suddenly, the whole space came alive: there was no visible change, but I heard waves lapping against a shore. I slowed down and stepped aside to see what was going on. Everything became quiet again. I observed water drops falling from above; they were like falling crystals, shining in the light. I noticed a struggle between the rainbow and the falling water drops, which disrupted the prism's effect. The colors of the rainbow blended and mixed as the drops of water, continuously disturbing the tranquility of the reflective water surface, fell. I could have sat there for hours, observing this interplay between light and water. After a while a person walked in and an unexpected performance started. At first I didn't see anything; I just heard waves. Slowly the pattern on the surface of the water curtain became visible. Falling water followed the person walking along the fountain and formed a parabolic wave image on the surface of the water curtain. Then some more people came and the performance continued. I sat there for a while enjoying subtle visual and aural changes, and almost forgot that I was in a hurry, it was so calming and relaxing. . . .[1]

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[1] This is the description of a possible experience of the *Interactive Water Curtain*, the water fountain which I designed in the past year. Its detailed description, accompanied by conceptual drawings is to be found in the Appendix of this thesis work.

WHAT IF?

What would architecture look like if one were to pay attention solely to the composition of sounds, as if the visual appearance were not important at all? What about smell? Can we identify a space just by its smell? Probably there is little sense in all these questions; but are we really conscious of how important all our sensual experiences are as we form our impressions of a particular place?

There would be no Gothic cathedral without a reverberating sound that gives "heavenly" modulation to a voice, nor any Greek theater without the exceptional acoustics where the sound of a pin dropping can be heard distinctly from each of the seats. There would be no Egyptian or Mayan temple-structure without careful attention to time and the position of the sun at the cardinal points of the year. There would be no Persian garden or Buddhist temple without a concern for scents, and there would be no Chinese garden without an awareness of natural cycles.

What about architecture today? How much attention do we pay to sound, smell, time, or natural cycles when we design our buildings, gardens, and cities? How much do we really understand ancient architectural traditions? Will the development of Virtual Reality change architectural design as well as our understanding of how we actually perceive the environment we live in? All these are questions that spur my curiosity. In the following text I attempt to answer some of them.

ART AS EXPERIENCE

Art as experience -- this is the focus of this thesis: art as experience integrated within an architectural structure, hidden from a person who walks along in a rush and inviting to a person who slows down and gets involved in discovery. The focus is therefore art, which is structurally integrated into architectural space indoors or outdoors; art, which deals with natural phenomena or media, such as natural light, water, time, smell, natural cycles; art, which is either very simple or high-tech and high-knowledge; art, which transforms natural media from one form into another; art, which disintegrates natural media into separate parts or emphasizes only one aspect in order to emphasize its nature; art, which changes through time and is sensitive to the changes within an environment; art, which becomes fully visible only through attentive observation and participation; art, which is based on surprise and discovery.

The word *art* may be used interchangeably with terms like skill, cunning, artifice, or craft, "but in its most distinct sense it contrasts with them in implying a personal, unanalyzable creative power" (Webster's Dictionary). It

is also defined as "the conscious use of skill, taste, and creative imagination in the production of aesthetic objects" and other artistic works, as well as the "skill in performance acquired by experience, study, or observation." It can also refer to learning itself, and this is what *art as experience* is all about: it is about learning to observe.[2]

Art is something that happens in an observer's mind. In this case, every person is an artist, and the act of making art is experiencing. Art, therefore, is not an object. An object, an environment that provides a possibility of a certain experience, is not art, but only an artistic device, which, through an observer's interaction, can make art happen. Such art integrated within an environment is not so much concerned with providing a particular artistic experience. It concerns observation, leading one's attention to experience an environment in many different ways; it concerns teaching to "see;" teaching to use all the senses to create an experience -- art.

ART INTEGRATED WITHIN ARCHITECTURAL SPACE

I use the term *architectural space* in a very broad sense. It can be the space of a room, a building, or the space of a city structure. Therefore, it can refer to indoor or outdoor environments, to the small scale of a patio or the vast scale of a city.

Traditionally, *art integrated within an architectural structure* would be understood as a sculpture or a stained-glass window or a painting integrated within the walls of a building. In this discussion, the definition will go far beyond these widely accepted limits. The artistic media of my interest are sunlight, water, sound, smell, views, natural cycles, and even time.

Sculpture is defined as *a three-dimensional work of art*, and since all these media manifest themselves in three-dimensional space, they have some sculptural properties. Sunlight, as a play of light and shadows, is two-dimensional; however, the three-dimensionality of a window, the ingenious manipulation of a space, or the use of movement can make light appear three-dimensional. Water is already volumetric; light can only emphasize its voluminosity. Sound is partly the property of space; the ingenious manipulation of a space's shape can produce different sound effects. Smell derives from a very small concentration of fragrances in the air; therefore, it already appears to be spatial. Views, as selected prospects or sceneries of spatial arrangements of objects, are *pictures in space and time*. Natural cycles, essentially connected with the movement of the Earth, are not just three- but at least four-dimensional. Finally, time is a celestial movement as we

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[2] Many contemporary environmental artists share the same kind of philosophy in their work. More is written about that in the first two chapters of the thesis.

experience it from Earth, therefore, it is at least four-dimensional.

There has been a great deal of critical interest in the topic of the relation between architecture and sculpture. My interest is not so much in sculptural architecture, since sculpture tends to be a space for experiencing, while architecture tends to be a space for living, and those two functions do not necessarily coincide. I prefer to speak about art that is integrated within architecture, art that is a partly obscured element of our living space. I do not have in mind decorative elements which can be hung on walls, but artistic elements which themselves are walls, roofs, light-fixtures, functional elements as well as structural elements of a building or any other kind of architectural structure. In the second part of this thesis (Nature as Artistic Medium in Architecture) there are numerous examples of such kinds of art integrated within an architectural structure. Charles Ross' prismatic windows that fill the interior with spectral colors, or James Carpenter's windows made of dichroic glass that splits the spectrum are examples of artworks that use the physical properties of light in creating visual effects.[3]

Water walls and water curtains are quite often used in contemporary commercial buildings to mask unpleasant environmental sounds. These structures are usually rather simple; however, by employing sophisticated technology one can be much more creative and design structures that will change monotonous masking sounds into melodic environmental "music." An example is my proposal for *Interactive Water Curtain*, which is described in detail in the "Appendix" of this thesis.

If a lot of attention had not been placed on the reverberation of sound in an architectural structure, there would be no Gothic cathedral. With the same attention to sound, one can design an architectural space that will incorporate special sound effects. This can be a seven-fold echo heard from a particular place in the structure. The Muslim tradition provides us with examples.[4] Even though these sound effects are a side product of a particular dome-design, there is no reason why they could not be used intentionally and why they could not be incorporated into an environmental art piece.

Smell, the characteristic of a place to which contemporary architects rarely pay any attention, was very important in the design of the Alhambra and the Persian gardens, which were designed as environments for all the senses. The famous Court of the Myrtles in the Alhambra, did not get its name because of two lines of trimmed evergreen myrtle bushes, but because of the myrtle's strong scent that gives its identity to the court.

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[3] Detailed information about both examples are to be found in the chapter on Light.

[4] Shah Abbas Mosque in Isfahan (1640 A.D.) described in the chapter on Sound.

The integration of interesting *views* of the exterior, as well as the integration of *natural cycles* into the composition of the interior of a Chinese or Japanese traditional house as *ever-changing pictures in space and time*, are other possibilities in architectural design that are almost completely unused. Why do we not use the Japanese technique of *shakkei*, or borrowed-scenery, and design small atriums as ever-changing pictures in space and time to view from inside.

And finally, how can we understand ancient Egyptian and Mayan temples or understand their cultures without understanding the time-watching function of those temples? Time is a celestial movement, and solstices and equinoxes are not really points in time but points in space, which can be observed and measured. The Infinite Corridor at MIT can be a time structure. Instead of measuring the cardinal points of the year that were important to the ancient cultures, it measures November 12th and January 27th sunsets.[5] These are the days when the rays of the setting sun penetrate the whole length of the Infinite Corridor. What if we were to use this specialty of the MIT architectural structure, sculpturally emphasize it, and prepare a yearly cultural event that would take adwantage of this happening? Would we call these sunsets "art integrated within an architectural structure"? Why not?

DECONSTRUCTION OF EXPERIENCE AS A STRATEGY FOR MAKING ONE "SEE"

Deconstruction is composed of the word *construction* and the prefix *de-*. According to Webster's dictionary, the term *construction* can refer to "the arrangement and connection of words or groups of words in a sentence," or can refer to "a nonrepresentational sculptural creation composed of often disparate elements." It can also refer to "the process, art, or manner of constructing," as well as to "the act or result of constructing, interpreting, or explaining." Construction can be, therefore, both an arrangement or composition of different elements, as well as the composition's interpretation. Since the prefix *de-* means "the opposite of" or "the reverse of," *de-construction* can be understood as de-composition or separation into constituent parts, elements, or into simpler compounds. However, it can also be understood as non-interpretation, giving a viewer opportunities for her/his own interpretation.

In this context, deconstruction has three meanings: it is deconstruction of our total sensual perception into separate senses; it is deconstruction of natural media into its composite parts; and it is de-construction in the sense of being

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[5] This is true for the leap years, when the winter solstice fells on December 20th, and this year (1993) was a leap year. Otherwise, the winter solstice is on December 21st, and the "MIT's sunsets" are on November 13th and January 28th.

open to various interpretations.

Spaces are created by many means other than physical walls. Even though we are mostly aware of our visual perception, we experience an environment with all the senses -- vision, touch, smell, hearing, and even taste. To make sense of all the sensual information we receive, we use acquired knowledge. Our experience is holistic and usually we do not necessarily separate different sensations from each other. The total impression of a space is that it either feels pleasant or unpleasant. Satisfied with that information, we usualy stop. However, many times we want to know what exactly the "pleasant" or "unpleasant" is. Is the reaction based on sight, sound, smell, or touch? In this manner, we start to analyze the image's[6] separate parts.

When I talk about deconstruction of experience as a strategy for making one "see," I have in mind this very kind of de-composition of our sensual perception. In order to be aware of sound, one has to listen. In order to be aware of smell, one has to smell. In order to be aware of natural cycles, one has to observe a particular cycle. For example, one can create an interesting sound effect that can be experienced only through attentive listening from a particular position in space. The effect can be a rather intense experience. However, it can be completely unnoticed by a person who does not pay attention to it. Therefore, drawing one's attention to this particular experience is very important.

In order to draw one's attention to a particular experience, one has to use various media to convey the necessary information. If, for example, there is a lobby with a unique echo effect that can be heard from a specific point in the lobby, but very few people know about that, there is little use in this effect. However, with the ingenious manipulation of this information, the sound effect can become the focal point of the building and give an identity to the place. In order to achieve that, the point from where the echo effect can be heard should be emphasized, for example, by marking the spot with a design of the floor and naming the lobby *The Echo Corner*.

The name of a place itself already conveys a lot of information. If a place's name is the *Fragrant Garden*, we know that we are supposed to pay attention to smell, if it is the *Humingbird Garden*, we know that we are to observe humingbirds, and if its name is *The Alley of the Rising Sun*, we know that we are to experience a magnificient sunrise on a winter solstice, for example. It is not always that simple, but, as we go along, we learn that the *Myrtle Court* is not only a place with trimmed evergreen bushes and a long water mirror, but also a place where we can enyoy the pleasant smell of myrtle.

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[6] I use the term *image* in an extended sense; it can refer to a visual image, a sound image, a smell image, a touch image, etc. -- an image that we form in our mind.

As mentioned before, deconstruction can also refer to de-composition of natural media into separate parts. This is especially important when we deal with natural media that we experience every day. For example, light and shadows are a part of our everyday experience of the world around us, therefore, we rarely think about light and shadows themselves. However, if we look at light in a slightly different way and try to see shadows, we can find some interesting possibilities for our artistic expression. Cast shadows or light patterns on the walls and floor of a building can be an interesting kinetic element in the composition of environmental artwork. An interesting contemporary example of such a use of light is Ando Tado's *Chapel Mt. Rokko* in Kobe, Japan, in which a strip of light coming through a narrow opening in the ceiling falls onto the church altar, subtly integrating itself into the composition of the altar.

In addition, light itself can also be deconstructed into its spectral components using a prism or dichroic glass. When the interior of a building is illuminated through prismatic windows[7] that refract sunlight into a spectrum, we can see all the spectral colors. This refractive light tells us about the nature of light, it tells us about the physics of light, it tells us that light is a mixture of different lengths of electromagnetic waves, which we can experience in such environments.

When art's focus is experience itself, this necessarily implies the removal of the artist's interpretation from that work of art. Through an artwork, one is only led to concentrate on a particular sensation. In this case, an artwork is only a physical arrangement of space that provides a possibility for a particular experience to happen. Therefore, it is open for a visitor's own experience and her/his own interpretation.

This kind of dezintegration of the totality into its composite parts is not new. This is the basic principle of scientific research, which takes everything apart in order to understand the whole. Therefore, deconstruction of experience is nothing more than separating the one from the whole by leading one's perception to focus on the chosen element in order to make one aware of it.

THE ELEMENTS OF PUZZLE, EDUCATION, AND DISCOVERY

The elements of puzzle, play, ambiguity, and discovery are very important in attracting people's attention. This is especially true when the artistic media are elements from our everyday life. We do not usually see shadows, we do

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[7] Charles Ross and James Carpenter used refraction of light in some of their light-designs in architecture.

not notice drops of water, we do not hear wind, if there is not something special about them that attracts our attention.

There are some remarkable early examples of surprise elements integrated into the fountains of Italian Renaissance gardens.[8] One of the most common are water tricks such as in the *Owl Fountain*[9] in Villa D'Este in Tivoli. When a person steps on special tiles, she/he activates tiny jets of water that spurt from unexpected directions.

Contemporary examples that use the same kind of principles are participatory artworks designed by Joan Bringham and Christopher Janney. In their temporary installation *Steamshuffle*[10] they used a photoelectric eye to provide for participation with their piece. When a person, moving through the artwork, cuts the beam of a photoelectric eye, she/he triggers a steam jet and a voice reading a line of poetry, emitted by a synthesizer. One can, therefore, experience their artwork through the sound of concrete poetry[11] accompanied by the sound of releasing steam, while observing the appearance and disappearance of portions of written poetry on plexiglass plates. The other quality of the installation is its quiet presence -- the sculpture is waiting, always prepared for people to come and interact with it. So, as soon as people arrive, the sculpture awakens and starts its lovely performance. This shows some of the incredible potential for the creative use of technology in order to make natural media appear alive and to attract people's attention.

When I speak about art integrated within an architectural structure, I have in mind art that is integrated into every-day life, art that happens on one's way to work, that explains or shows natural processes and phenomena in a slightly different and interesting way. I have in mind art that is in a way invisible: it is there, it is present, one can feel it, but it is not obvious. Such art could be a discovery, a surprise, or maybe a puzzle. Since it deals with everyday experiences, something about such artwork should be significantly different in order to attract people's attention. The subject should be presented in an unexpected way that is different from everyday experience. This would add the feeling of ambiguity and attract our curiosity to find out what is going on. Such is my *Interactive Water Curtain*, where different experiences of the piece unfold depending upon how a person approaches it. It provides mostly sonic experience when a person is close to the fountain, and mostly visual experience from a distance when a person observes the fountain's interaction with the people passing by.

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[8] Many of these water tricks can be traced back into the history of the ancient Romans if not the ancient Persians and the Egyptians.

[9] For detailed description refer to the section on Water.

[10] More detailed description of the artwork is to be found in the section on Water.

[11] Concrete poetry is a form of poetry where separate lines are mixed together randomly to form one solid poem.

When a special effect of a particular environmental artwork is too hidden, it needs to be explained, like in a puzzle book. When you give up, you can always turn a page and look for the solution. In a butterfly garden, for example, the unusual presence of butterflies and their caterpillars fit into the composition of the work, and can be explained through poetry written artistically on walls, just like verses written on garden walls in a traditional Chinese garden. A butterfly garden does not need to be a "zoo" to show the life cycle of a butterfly to explain how the creature fits into its total environment. It can be poetry that tells even more.

PSYCHOLOGICAL ASPECTS OF PROVIDING THE EXPERIENCE OF NATURE

Sociologist Alvin Tofler in his book Future Shock writes about the threat of our limited ability to cope with the accelerating experiential novelty of urban technological civilization, which has both physical and psychological consequences. In contrast to the constant change of objects in a human-made environment, a natural environment with its slow changes still represents a condition of permanence and stability. Therefore, using natural media, such as water and plants, to correct negative sensory experiences in hectic man-made environments is an important psychological function that nature can provide.

An example of such an environment can be found in crowded and noisy New York City. In the Greenacre park, the cascaded water wall, which produces a constant rustling sound, provides a quiet and fresh environment to anyone who walks a few steps into it, even though the view of busy 52nd Street is not obscured. The relaxing sound of water covers the noise from the busy street and makes the park appear psychologically quieter.

Natural media such as water and fire have relaxing, stress-reducing effects which can be psychologically liberating. Fire, with its crackling sound and ever-changing pattern of flames, and water, the most vivid among inorganic elements, with its reflections and pleasant sounds, are therefore media with great potential for providing relaxing, contemplative environments that are becoming increasingly important for the contemporary citizen.

What really attracts people to water and fire is their subtle, ever-changing appearance, which one can observe infinitely. Interestingly, as the "Fish experiment" showed, people are not attracted only to water and fire, but also to a still recording of tropical fish in a glass tank. One Californian TV station decided to open a new channel to produce live recordings of a fish tank. After a month the transmition was stopped; consequently, they got several calls from disappointed viewers asking when the Fish would be back. This shows that the psychedelic effect of any kind of constant, ever-changing, subtle

movement attracts people's attention because of its passive, relaxing, contemplative effect. Therefore, an ingenious manipulation of any kind of natural media that have such qualities can be effective.

Besides offering environments for relaxation and contemplation, nature as a medium in architecture gives us an opportunity to design a sensually richer environment that does not provide us just with visual satisfaction, but that satisfies all other senses.

Today the majority of the western population lives in urban, man-made and highly controlled environments. We are alienated from nature and natural phenomena, as well as from ourselves and our own senses. Attracted to man-made representations of nature, presented through photography, gardens, paintings, films, etc., many people today have difficulty appreciating "wild nature" as well as noticing nature at all. We live in the virtual world of TV and computers, overwhelmed by information offered through different media, and consequently, do not notice the richness of the (dying) natural world around us.

Much of indoor architectural space today does not provide us with the experience of the natural rhythm of seasons and the daily change of light. We are celebrating technology and our victory over nature, forgetting that the god of technology is a god of destruction as well. There is a need to design environments which remind us of our connection to nature, if not our dependence on it. In such environments, technology will celebrate nature rather than itself. Instead of painting the floor and illuminating the space, let the sun light paint it, illuminate it, and constantly change it over time. Instead of having paintings on the wall, let the window be a frame, and let the plants in a garden, changing over time, serve as pictures, viewed from indoor spaces. Instead of making sophisticated splashing fountains, let the rain-water make waterfalls, emphasizing a rainy season and celebrating the power of nature.

There are many references in the history of architecture which give us examples of interaction between built structures and the natural environment. The essential element of an ancient Roman house -- the *impluvius*, for example, is a fantastic fountain. We can imagine it in a heavy rain: a blue cube of water glowing in a dark space around the *impluvius* where people sit and enjoy the manifestation of the "goddess of rain." After the rain, we have a different effect: drops of water falling from the edge of the roof making dripping sounds in a water mirror below, and a water mirror reflecting sky and traces of dancing drops all over the space. In a hot summer day, a water mirror provides freshness and invites us to play with water which eventually means a play with light as well. Slowly growing ice-candles, shining in the light of chandeliers, provide a fantastic winter experience. Unfortunately, we have forgotten a lot of that simplicity in our everyday world, where one may get an impression that everything would have to flash and glow in aggressive fluorescent colors.

VIRTUAL REALITY AND THE FUTURE OF ARCHITECTURE

Development of computer design programs that allow more intuitive applications are already changing the process of architectural design, and I believe that the development of Virtual Reality will change the process even more. More than the process, the architectural design itself will change. We already know that the computer can be programmed to do "better" hand-crafted work than the best artists. Does this not imply a possibility for using complex decorative details and still keep the price down? We also know that Virtual Reality will allow us to enter an environment before it is built. Does this not mean that one can actually test various effects that an environment has on the observer and redesign the undesired?

Does this mean that the development of computers, and especially the development of Virtual Reality, will change architectural design as well as our understanding of how we actually perceive the environment we live in? In Murray Schafer's opinion, architects stopped using their ears in designing architectural spaces at about the time of the Renaissance, with the development of the printing press and perspective painting, which to a large degree have diminished the experiential potential of newly-designed environments. A printed page or drawing cannot convey sonic information about an environment. Virtual Reality can. Without visiting one of the gothic cathedrals one can hardly understand the reveberating sound that is so characteristic for Gothic sacral architecture. A Gothic cathedral is not just its form, it is also its sound. Maybe it is still too early to speak about more intuitive methods of acoustic design employing Virtual Reality; however, just the possibility that one can use sound in designing places and actually convey sonic information will change the way we design and perceive the environment we live in.

If the living experience of Virtual Reality will alter the focus from an object to the experience itself, a future architect will design the shape of a space according to a desired sound image. The same might be true with all the other senses. This alteration of the focus from an object to the experience itself will in turn bring attention to the real world and to the possibility to fully observe it through all our senses.

Employing computer aidded design in architecture does not just change the process of design but also its complexity. Computer models can easily employ acoustic and light design or even astronomic planning. Therefore, if a certain built-structure, for example, because of its function requires a large lobby whose basic form allows a creation of a special sound effect, why not use that effect and give the lobby a special identity? Or, if a built-structure requires a long corridor, why not align it perfectly with one of the astronomical axes to get a magnificient sunrise experience, when the rays of the rising sun will penetrate the corridor's entire length and illuminate "performing mirror

sculpture," the main attraction for the New Year 2000's celebration? Why not to use various devices to make architectural structures highly responsive to the natural environment and design special effects accordingly?

It seems as though we are going backwards into the history of ancient cultures. These cultures employed astronomical planning to tell a proper time to propitiate gods. They used light, sound, and fragrances to create a proper home for gods, and used views to elevate themselves into a different reality. Today, however, we are celebrating life -- the joy of living and experiencing.

In the following two parts of this paper I further explain the basic ideas of my view of design principles, which, I believe, can generate sensorilly richer and more pleasant environments. The first part discusses some general trends in contemporary society in order to place my own view of design within a broader context, while the second part lists numerous examples from the history of architecture and art to illustrate and expand my philosophy.

PART 1 - GENERAL TRENDS

ENVIRONMENTAL ART AS A STRATEGY FOR REORIENTATION IN NATURE

The work of art is to appeal to the senses,
to satisfy sensual needs -- but in a highly sublimated manner.
Art is to have a reconciling, a tranquilizing, and a cognitive function,
to be beautiful and true.[12]

                                          Herbert Marcuse

In this century we have witnessed an artistic attack on art in all its forms and a constant questioning of the function of art in contemporary society. After Modernism, which was a break from the concrete to the abstract, we have witnessed a rebellion against the reductive expressed by the slogan "less is more," against an art-for-art's-sake emphasis in form or image alone, against commercialization of art, and against the mere aesthetic role of the arts. These trends have resulted in reorientation from object to experience and in a gradual upsurge of the need to redefine our values in social and environmental contexts -- the need that many artists feel today. In turn, such redefinition adds political and educational functions to the arts.

Philosopher Herbert Marcuse in his essay *"Art As a Form Of Reality"* argues that the rebellion against the form of art is the rebellion against the form overwhelming the context:

> The protest continues in the renewed efforts to "save" art by destroying the familiar, dominating forms of perception, the familiar appearance of the object, the thing because it is part of a false, mutilated experience. (Marcuse p.130)

Further he explains that:

> The development of Art to nonobjective art, minimal art, antiart was a way toward the liberation of the subject, preparing it for a new object-world instead of accepting and sublimating, beautifying the existing one, freeing mind and body for a new sensibility and sensitivity which can no longer tolerate a mutilated experience and a mutilated sensibility. (Marcuse p.130)

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[12] This is the way Marcuse described the central idea of classical aesthetics.

Environmental art is a very broad and elusive term that can include anything from the design of a room-wall to the master plan of a city and can explore any theme from a particular environment: daily and seasonal changes of light as in Nancy Holt's *Sun Tunnels*, lightning as in Walter De Maria's *Lightning Field*, or movement of birds as in Christopher Janney's *Bird Dance*. Therefore, environmental art can be seen as the "maximal form of expression,"[13] as pointed out by Nicholas Capasso.

The most important characteristic of environmental art its expansion from an object within an environment to an environment itself. Early environmental artists, such as Michael Heizer, Robert Morris, and Walter De Maria, moved art from the commercial gallery space into vast natural environments. Their landscape objects could not be contained in a gallery and/or sold for profit. Their canvas was the earth. In the opinion of some critics, they "used earth as a neutral material to express a formalist approach to art making"[14] on a vast scale. However formal their expression seemed to be, they greatly expanded the possibilities for artistic expression and added some new concepts.

Michael Heizer, for example, with his *Double Negative* (1969-1971) in Nevada, made the same statement in sculpture as John Cage did in music:[15] negative space is as important a part of space as positive space itself. In his earthwork *Double Negative* he made two cuts into the Virgin River Mesa and displaced 240,000 tons of rhyolite and sandstone to create a negative structure. With this sculptural statement Heizer took the classical perception of sculpture as positive form and expanded it to sculpture as negative spatial structure.

The increased interest in creating artworks that are created in a context of their environments is another characteristic of this change of focus from an object separated from an environment to an environment itself. Robert Morris' *Observatory* (1971) in the Netherlands, for example, marks solstitial and equinoctial sunrises. Time is a celestial movement as we experience it on Earth; therefore, by including the fourth dimension, an artwork is built in the context of the solar system.

Early examples of environmental art were the bellwether of a new wave of environmental awareness. Morris in his *Observatory* makes us aware of the essence of time -- its rootedness in the celestial movement. Heizer makes us aware of the three-dimensional space itself. Environmental artists want us to

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[13] "Environmental art has been identified as a reaction against the self-referential, strictly formal content of Minimalism. Such art, then, reflects an expansion of associational values from the absolute paucity of Minimalism. So vast is this expansion that environmental art could conceivably be referred to as a maximal rather then a minimal form of expression." (Capasso, p.73)

[14] Floria in "The Ecological Art Explosion," p.100.

[15] Silence is as important a part of music as sound itself.

be physically present in their artworks and to actively experience them. The focus of art moved from an object (in this case the environment) to an experience itself.

This is especially true in the Walter De Maria's *Lightning Field* (1977) in New Mexico, which is a good example of this kind of art. The *Lightning Field* is composed of 400 stainless poles arranged in a grid over the mile/kilometer area, and planned to attract lightning and thereby to celebrate its power and visual splendor -- electrical discharge. In the *Lightning Field,* the observer is offered a number of different experiences. There are the experience of a vast empty space of desert, the experience of distance (mile versus kilometer), as well as the experience of the grid as the orientational system, which one can observe visually or kinesteticaly moving through the artwork. Then, there is the most attractive experience of the *Lightning Field,* the experience of electrical discharge and its various manifestations: as lightning, as thunder, or as static electricity in the air. These experiences are accompanied with the experience of fear, danger, beauty, and joy -- a variety of strong emotions that appear in the observer each time the "performance of electrical discharge" occurs.

Environmental artworks such as Walter De Maria's *Lightning Field* require a new kind of sensibility. Through the established aesthetic values those artworks cannot be fully perceived and understood. Their emphasis is on the experience itself. One can find aesthetic pleasure experiencing it as a photograph; however, one has to physically enter the artwork to experience it as a complex orientational structure or as the sometimes frightening electrical discharge field.

This kind of new sensibility requires expanded awareness and depends on attentive observation:

> The aesthetic object is . . . without any relation to a subject other than that of pure contemplation -- pure eye, pure ear, pure mind. Only in this purification of ordinary experience and its objects, only in this transfiguration of reality do the aesthetic universe and the aesthetic object emerge as pleasurable, beautiful, and sublime. (Marcuse, p.129)

As stated by Capasso, this orientation to experience can be seen as "a strategy for reorientation in nature." This means that environmental art can establish a set of values through which the observer's attention is altered in order to emphasize certain obscured processes or phenomena. In the case of the *Lightning Field,* a "set of values" is the arrangement of metal poles themselves, waiting for the observer to visit the site and explore it.

Guiding the observer's attention to a particular natural process or phenomenon increases awareness of the environment in which we live. This is especially important in the case of ecological art. For many ecological artists,

such as Alan Sonfist, or Helen and Newton Harrison, the art's function is to promote environmental awareness and to reinforce a sense of global responsibility. In their work they include obscure natural processes and relations previously seen only through careful scientific research. This, however, creates an educational and political role in this kind of art.

The function of art in society has become one of the main issues today. For the German conceptual artist Joseph Beuys, art is an instrument for social transformation.[16] This, however, was also the case in prehistoric societies, as suggested by Lucy Lippard. In her book Overlay: Contemporary Art and the Art of Prehistory she argues that in prehistoric societies, the political, religious, and educational functions were integral parts of the arts' communicative role. She sees that if the art is to be alive, the same should be true today. She says that:

> Effective art [is] that which offers a vehicle for perceiving and understanding any aspect of life, . . . [and it becomes effective] by being created and communicated within carefully considered contexts. (Lippard, p.5)

Therefore, art that tries to communicate and make us aware of different dimensions of reality is effective, living art.

The break from *art as product* to *art as experience* implies a break from *artist as a person who makes art* to *artist as a person in whose mind art happens*. This correlates with Joseph Beuys idea that "every person is an artist" since everybody is capable of experiencing. Environmental art's political/educational role, therefore, can be seen as a strategy for reorientation in nature, a strategy which establishes a set of values that enables us to perceive environment in a new way, and that enables us to become aware of things we do not usually pay attention to. The function of environmental art, then, is to prepare the environment in such a way that "natural" events may be enhanced when they occur.

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[16] Beuys was very much involved with the establishment of the Green Party in Germany.

ECOLOGY AS A NEW WORLD VIEW

From the ecological view one can see that,
since life is only transmitted by life, then, by living,
each one of us is physically linked to the origins of life
and thus -- literally, not metaphorically -- to all life.

Ian McHarg

In his book The City in History, sociologist Lewis Mumford says that ancient civilizations, such as Egypt and Rome, "suffered from the vice that now threatens to overwhelm our own civilization in the very midst of its technological advancement: purposeless materialism" (Mumford, p.112). Once such an extreme materialism meant a destruction of a civilization; but today, because of our highly developed technology, one that has enormous power to change the environment, humanity must confront the cruel reality of the possible genocide of our own species. If humans are to survive, therefore, we must establish a new system of values which will allow us to re-establish a symbiotic relationship with nature and perhaps develop some other inner potentials.

Growing ecological problems caused the birth of *ecology*, defined by Webster's dictionary as "a branch of science concerned with the interrelationship of organisms and their environments." The term *ecology* can also be used not to denote a branch of science, but concretely to refer to "the totality or pattern of relations between organisms and their environment." The environment itself is defined as "the complex of climatic, edaphic, and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival." Extending the concrete sense, *ecology* can also refer to "the aggregate of social and cultural conditions that influence the life of an individual or community."

Contemporary research in ecology has made it clear that we must re-examine our values and redefine them. In his book Design With Nature (1969), landscape architect and urban planner Ian McHarg writes:

> In times long past, when man represented no significant power
> to change nature, it mattered little to the world what views he
> had. Today, when he has emerged as potentially the most
> destructive force in nature and its greatest exploiter, it matters
> very much indeed. (McHarg, p.26)

In the words of Californian artist Newton Harrison:

> We've been very alienated from our resources, but our time of
> grace is over. The idea that technology is able to buy us out of
> our problems is an illusion. We are going to have make vast
> changes in our consciousness and behavioral patterns, because
> if we don't, we won't be here." (Art in the Land, p.100)

And the urban planner John Papaioannou ironically adds:

> Ecology teaches us that every living organism in nature -- in,
> say, an ecosystem -- is inextricably interconnected, through an
> extremely complex network of ties, with practically every
> other one within the same ecosystem, whether human scientists
> have already identified all such ties, or not. (Papaioannou,
> p.255)

The relation of humans to nature differs in different historic epochs, and is in
direct correlation with culture. In the Middle Ages, people were essentially
afraid of nature, although nature had mostly a utilitarian value. On the other
hand, in the Renaissance, people managed to subordinate nature, which later,
in the Baroque period with its gardens and city structures, resulted in the total
domination of humans over nature. In the Renaissance, however, nature
became the most important source of inspiration. With the Enlightenment, the
sacredness of the environment gave way to the exploitative goals of an
emerging industrial society which, with the help of the new ethics of
engineers, redefined the beauty of the landscape into the basic value of
maximal efficiency.

Today, in general, the human relation to the natural landscape is one of total
domination. This view was not problematic in times when humans did not
have significant power to change nature. In the past century, however, we
have emerged as potentially the most destructive force in nature, and with the
development of genetic engineering our power will be even greater.

"A great erosion has been accomplished," says Ian McHarg, erosion that has
"diminished nature -- not only in the countryside at large, but within the
enlarging cities and, not least, in man as a natural being" (McHarg, p.19).
Alienated from nature, we rely on secondary sources of information rather
than looking at the direct source -- nature itself. This is a problem. In our
agricultural past, a farmer took time to observe relations among different
events that occurred in nature, because his/her prosperity depended on his/her
understanding of the land and his/her ability to manage its bounty. Crop
rotation, which prevented the earth from being depleted, was the result of long
observation by many generations that accumulated into the empirical

knowledge of agricultural societies. It represented a cycle of renewal, returning the land to a fertile state. In contemporary society, we replaced the crop rotation cycle with fertilizers, replaced birds (that protected crops from insects) with insecticides, and "displaced" ourselves from the countryside into large cities, bringing with us only an image of a beautiful landscape, emptied of the comprehension of nature's ultimate essential character.

The acquisition of knowledge and technological power has not changed our attitude to nature. In the battle to save our future, it is still the pre-Copernicans whom we confront, and this failure to change our view represents a human problem. In the human play called Progress & Profit, nature is an irrelevant backdrop. When "nature is brought to the foreground, it is only to be conquered -- [we are] man versus nature" (McHarg, p.44). In this sense it becomes obvious "that man, while the current, latest dominant species, may not be an enduring climax" (McHarg, p.44). In this view, the place of human beings in nature is less certain: nature will survive with or without us.

The artificial division between people and nature characteristic of a Newtonian era will have to give way to a new unity. The source of the most generally accepted description of the human role in nature, the first chapter of Genesis, defines *human* as *master of nature*. Do we think we have scriptural license for exploitative behavior? If so, our thinking will have to change. We will have to adopt the role of *guardians of nature*. As our increasingly polluted and degraded environment shows, to be master of nature does not entail the right to exploit nature, but at most to manage it. Even this concept will have to be replaced by that of the *human in nature*, to reflect the principles of harmony, equilibrium, and wholeness that must become the most important guide for all human actions. As McHarg points out:

> Where you find a people who believe that man and nature are indivisible, and that survival and health are contingent upon an understanding of nature and her processes, these societies will be very different from ours, as will be their towns, cities and landscape. (McHarg, p.27)

> A basic, inescapable principle is that [nature] has to be viewed as a unified, functional whole: one has, for example, no right to separate, isolate, or select for preservation, individual constituent elements of it. We shall call this *the New Ethics* principle, extending the concept from classical Ethics, which concerns relations exclusively between humans, to the broader field of all elements of nature. (Papaioannou, p.254)

Putting nature in the foreground "reverses the right to justify man as not only a unique species, but one with the unequaled gift of consciousness" (McHarg, p.44). This gives people an opportunity to redefine the value system we live in, and to develop ecology, a system of relations between people and the natural environment, into a new world view.

Over the last two decades, a variety of environmental catch-phrases, such as *green cities* and *healthy cities,* have appeared, reflecting a common wish that we begin to think ecologically and holistically about the environment. The effect of this increasing ecological consciousness is apparent in many sectors of our culture and range from sustainable development and recycling to debates over disposable diapers. Not only ecologists and landscape planners, museums and galleries are increasingly involved in shows promoting environmental consciousness. Artists, who at the end of the last century had an interest in recording natural environments and generated awareness of nature's possible destruction, thereby possibly helping to establish the National Park Service, are now interested in recording harmful human actions, such as man-made ecological disasters, and are calling for action.

The number of artists who think that "art's function is . . . to promote environmental awareness" (Cembalest, p.99) is increasing. Artists such as the German conceptual artist Joseph Beuys extended the boundaries of traditional aesthetics from a consideration of the beauty of an object to the beauty of an idea. Healing the environment or healing society is the idea that is incorporated in the majority of his artworks and the idea, which influenced a large number of environmental and ecological artists all over the world.

> Artists now are exploring disciplines and interests that artists
> forty years ago would not have even considered territory. That
> territory is growing to include obscure processes previously in
> the domain only of scientific research. (Cembalest, pp.100-1)

Mel Chin used "hyperabsorbents -- rare plants that absorb toxins from contaminated soil" in his *Revival Field* (1990). For Rufus Chaney, a heavy-metal specialist at the U.S. Department of Agriculture, the artwork is a resurrection project, while for the artist it is a sculpture. Chin cast the seeds "in an artistic arrangement instead of a simple field plot." Such an "art piece," Chin commented, "brings attention to the problem, not just the solution" (Cembalest, pp.100-1). Similar example is by artist Viet Ngo, who developed an innovative system for using the tiny aquatic plant duckweed to filter pollutants from water and convert them into food for wildlife. He formed his own business in order to apply the system. "This is an industry. . . . I'm building you guys parks," says Viet Ngo. "They also happen to be a very efficient way to treat your problem" (Cembalest, p.105). The method cost half as much as a mechanical or chemical purification plant would.

San Diego artist Newton Harrison, together with his wife Helen Harrison, both influenced by Rachel Carson's Silent Spring in the early 1960s, have recently devoted their artwork to the exposure of vast ecological changes, such as global warming and the endangerment of natural ecosystems. They collaborate with numerous scientists and study the effects of pollution in various sites all over the world, and make proposals for the protection of the sites. Their study of one of Europe's last indigenous oak forests in former

Yugoslavia is one example. When one examines their artwork one notices that it is more closely related to the work of landscape architects and planners than to traditional art. This demonstrates the expansion of the boundaries of environmental art today. In their case, the difference between the work of artists and the work of landscape architects or planners is that artists can freely take into consideration cultural, political, aesthetic, and ecological criteria all at once, and through metaphoric expression unique to art, make all visible. In this way, the work of artists can take on explicit political and educational messages, while the work of planners many times stays within the limits of the field.

In September 1992, at the Queens Museum in New York, artists "attuned to . . . the interconnections of land, water, atmosphere, and also to the biosphere's delicate balance of life" put on the *Fragile Ecologies* show, which "heightens an awareness of . . . [our world's] rapid devastation." Through their work, artists "attempt[ed] to reestablish an equilibrium through community-oriented and educational projects."[17] So-called ecological artwork, therefore, ranges from picking up garbage, planting trees, creating wildlife habitats, and protesting against the killing of whales, to engendering ideas.

> The reason we have to participate is that we can do something
> that's very visual, very poetic; we have the power to sway
> people to our point of view . . . we can make a point about
> [the] impact on the environment. (in Cembalest, p.99)

So says Patricia Johanson, designer of *Lagoon* in the *Fair Park* in Dallas (1986). While arguing for "sculpture [as] a strategy for people to see nature," she designed the park with both ecological and aesthetic criteria. She used indigenous species of plants, fish, turtles, and shrimp to create a living environment including plant-shaped sculptures which create bridges, paths, and vistas. Initially shocking and not understood, the park is growing in popularity. It is even "attracting wildlife -- birds that hadn't been seen in the area before" (Cembalest, p.99). The substance and meaning of the artistic work have shifted from visual image to creating life itself, which a park that consists of indigenous species that attract wildlife defenitely is.

The role of artists in promoting environmental awareness is more an activist political work than traditional art. Such is *Eko-Dada*, as Austrian artist Wolfgang Podgorschek calls his art. In *Flora and Fauna Corridors* (1989), he makes the "suggestion that for every mile of freeway there should be another mile of untouched nature" (Cembalest, p.101). Similarly, New Zealand artist Andrew Drummond performed *Filter Action* (1980) on the site of a planned aluminum factory in order to question whether the soil could filter and absorb industrial by-products. "After the performance, artists and community members demonstrated against the plant, and the project was canceled" (Cembalest, p.102).

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[17] Barbara Matilsky in "The Ecological Art Explosion," p.99.

Alvin Toffler in The Third Wave says that:

> [The] techno-rebels are, without knowing it, agents of the *third wave*.[18] They begin not with technology but with hard questions about what kind of future society we want. They recognize that we now have so many technological opportunities . . . [that] the need to select more carefully among them and to choose those technologies that serve long-range social and ecological goals [is urgent]. (Toffler, p.151)

A number of biologists, ecologists and legislators have attempted to develop legal ethics that address our relation to the land such that natural objects such as trees mountains, rivers, and lakes are viewed as having a legal right to existence. The contemporary urban, short-term profit-oriented "displaced" have difficulty understanding simple ecological relationships (of life, death, and renewal among species in different natural systems) that were so obvious to people of past agricultural societies. Ecological science provides us with a complex knowledge of these relationships; however, a scientific language is sometimes too difficult to be easily comprehended and does not have the advantage of metaphorical expression that art does. Therefore, as some artists have argued:

> Art's role in this adventure is to help us experience personally and concretely what science demonstrates impersonally and abstractly. (Kustip in Design on the land, p.161)

Artists, through metaphor and decomposition, can emphasize certain chosen aspects of life cycles and make them visible, comprehensible, and easily communicable to a broader public. Ecological art, therefore, increases the public's awareness and helps to create the new ethic of our symbiotic relationship with nature.

The environmental, economic, and energy crises, which are already starting to limit and slow technological development, are probably the most important generators of changes in our value system. We are becoming increasingly conscious of the limits of growth, not just locally but globally as well. Because of global communication, we have finally started to perceive our home as the whole planet. We no longer see our "homeland" as an open system which can grow, change, and recover itself endlessly, but as a very sensitive, complex, and limited closed system. Awareness of limitations of our living space is therefore changing our exploitative attitude toward nature into one of a symbiotic relationship, where humans and nature are interdependent. The science of ecology is playing the major role in forming a base for a new consciousness, a new world view, which will penetrate every single area of our life.

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[18] The first wave represents agricultural society, the second, industrial society, and the third, informational society.

THE ARTS AS AN URBAN DEVELOPMENT STRATEGY

It is high time we ceased apologizing for the arts by suggesting
that they are the peanut butter on the mousetrap we use to catch tourists.
They are instead the bread of life.
                              Roger Kennedy

Many cities around the country are using the arts in an attempt to spur central-city redevelopment, to attract new business, and to compete more effectively with other cities and with their own suburbs. However, the presence of art in cities is, of course, far from a new phenomenon: world cities have long been homes for artists and centers of artistic and cultural production.

> What does appear to be relatively new, is the rise of an arts-centered strategy, and the specific composition of the development alliance that pursues this strategy. Along with traditional members of the urban growth alliance, arts organizations and historic preservationists are now included in a significant way for the first time, and the arts specifically are being used as the basis for urban redevelopment. (Whitt, p.19)

The arts are perceived as raising the quality of life and making cities more attractive to businesses. With the development of informational technology, however, the character of production changed: it could occur anywhere, having liberated itself from a previously limited range of locations. Therefore, as stated at the U.S. Conference of Mayors in 1987:

> The personal preferences of company executives and style of living for employees remain the most important corporate headquarters location factor. (Whitt, p. 29)

Although this may be true for choosing the location for corporate headquarters, the quality of life is not always a consideration for selection of location for other branches of a business. However, amenities that define "quality of life" are crucial to a new, emerging industry of cultural tourism; they not only affect it, but sometimes absolutely determine its development.

Not just the attraction which the arts holds for people, but also the distinctive identity of place and the use of greenery are important to raise the quality of life in cities. As stated in The Economics of Amenity:

> Cities with strong, distinctive identities are more likely than others to negotiate a successful economic transition in the coming years. (McNulty, p.141)

Therefore, using elements from the history of a place to emphasize its *genius loci* is important.

The term *genius loci*, which has become so popular in architectural theory in the last few decades, is a Latin term referring to *a spirit of the place,* which means a unique combination of spatial artifacts constituting a specific place. In ancient Roman times the term had a much broader meaning than it has today. For planners of antique cities, not only did materialized spatial artifacts and natural conditions (such as climatic conditions) constitute the *genius loci,* but metaphysical characteristics of the place did as well. So, the question for ancient Romans was, is the *Genius loci,* or the spirit which rules over a specific place, good or evil? In other words, was a specific place healthy and safe or unhealthy and dangerous? (Vitruvius in Ten Books On Architecture). Today, however, we are more concerned with the image of a place, with its beauty and uniqueness, than with health. Whereas in ancient times, *genius loci* had a holistic meaning, today it refers primarily to the appearance, or image, of a place.

That a "place itself is an amenity, representing the sum of all the amenities and other features of a specific locale that make it attractive" (McNulty, p.29), and that a place, a city, which is desirable to visit and live in will probably develop faster, are facts which we are becoming increasingly conscious of. Although a good physical environment may not improve a city's unhealthy economy, it can certainly enhance already healthy economic conditions. In this regard, it is interesting to note that:

> Private developers and business investors are viewing amenities as their insurance policy for major city investments. (McNulty, p.142)

This tendency on the part of developers and investors supports the prediction that:

> [In the near future], without a strong self-image, no city can expect to initiate and sustain a successful development program. (McNulty, p.142)

In the last three decades, much architectural theory has dealt with the problem of identity of urban artifacts. Kevin Lynch in his book The Image of The City developed a basic theory of how people orient themselves within the city and how they evaluate their environment and form a sense of space. A number of environmental ecologists argue that historic structures, such as districts or signs, help one to read and memorize the structure of a city. The presence of historic and natural elements, they say, increases people's appreciaton of a

place. Some interesting studies were carried out by Aldo Rossi, who argues that the form of an urban artifact has a much longer life than the institutions which build them. He sees the *genius loci* in the form of a city. In his book The Architecture of the City, he lists many examples of urban structures and shows how different cultures have left their trace in cities and how urban artifacts have been reused and adapted to new cultural conditions again and again throughout history. In Rossi's view, the specific form of an urban artifact, which is the result of natural, cultural, and historic conditions, constitutes the *genius loci*, which at the same time represents the materialized memory of the history of a city.

In the last two decades, contextualism as a principle of design has been widely adopted. Its "preservation attitude," which entails conserving or reusing old structures (possibly after adapting or transforming them) to keep traces in the memory of our physical environment, became the usual architectural practice. Expanding on the idea of a museum and applying it to a city structure, we may speak of a city as a *living museum*. The information about a place is left *in situ*, emphasized, and integrated within the new city structure itself.

This principle certainly applies to the redevelopment of large abandoned industrial sites, especially in North American cities, which occupy large segments of land in city centers and on city waterfronts. A good example of this kind of redevelopment is the Flats area in Cleveland.[19] One part of the plan for the revitalization of downtown Cleveland is to convert the Flats, the old industrial area, and the Terminal Tower complex into a unique civic center for leisure-time activities. This area is a mix of industrial, retail, residential, and entertainmant structures. It has a distinctive image of an old heavy industrial area with one of the greatest "collections" of 19th and 20th century bridge structures anywhere, forming a strong part of the city's *genius loci*.

The environmental art of the 1960s and 1970s moved beyond the walls of the gallery space into the space of the city and into a vast open space of desert. Similarly, traditional historic and natural museums lost their importance and are increasingly becoming part of an *in situ* museum, emphasizing the *genius loci* of the place. Ecological art in the 1980s and 1990s brought attention to nature and natural cycles and showed ways of aesthetically integrating nature into urban structure. In this sense, we do not speak just about natural processes as values (McHarg), but processes as part of the identity of a place.

It would be possible, for instance, to design a butterfly garden in such a way that the whole life-cycle of indigenous butterflies is observable. The garden would be outdoors, but not yet a zoo, and educational. Similar to this use of

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[19] Cleveland Civic Vision 2000 Downtown Plan, Cleveland City Planning Commission, Cleveland, 1988.

nature is the example of a water purification plant which was transformed into public art by Viet Ngo in Gorg, Italy. The work not only cleans and beautifies the environment; it also represents the citizens taking care of their environment.

Such artworks help guarantee a good quality of life, which is an increasingly important location criterion for a number of high-tech and informational businesses. Nature, then, at least as ecological and environmental art, is gradually becoming an integral part of the city, for ecological and psychological reasons, and also for economic reasons.

ENVIRONMENT FOR ALL THE SENSES

*"The greatest thing a human soul ever does in this world
is to see something . . .
To see clearly is poetry, prophecy, and religion, all in one."*
John Ruskin

However contradictory, life in contemporary urban areas may be perceived as highly stressful and sensually impoverished, all at once. Extreme changes in psychological and sensual stimuli, a result of a rich mix of various cultures and ideas on the one hand and various uses of technology on the other, may be too stressful for many people today. The excitement of living in a city, of being in contact with all sorts of people, cultures, objects, and ideas, where technology in all levels of our existence supports our life style, while perhaps desirable, can also be perceived not only as psychologically unbearable experience but also physically painful. A space for escaping, slowing down, relaxing, and contemplating is, therefore, an important need of contemporary urban people. Only in such places can peace and tranquility be found, and many people see these places as a road to the restoration of health. At the same time, while technology has enabled us to enrich our environment aurally and visually, it has also, to a large degree, obscured the subtle natural stimuli that constitute our everyday surroundings and that can be best perceived in "silence." Therefore, technological enrichment can at the same time be perceived as the impoverishment of our sensual environment. Thus, quiet places designed for contemplation, as well as places designed to appeal to all the senses and to stimulate daydreaming and wild imagining, are important for contemporary people.

In Japan, the arts of contemplation attained their most perfect form at a time when there was no social or personal peace, akin to the stressful lifestyle we endure today:

> Just as the tea ceremony and flower arrangement make
> frugality a virtue, creating with the simplest of means a world
> of stillness and beauty, so the dry rock garden, in the smallest
> of areas, created an ideal landscape, a garden for the mind. . . .

In Zen philosophy one is led to spiritual awakening by intuition through looking at the most primitive or simplest elements composing nature -- the simpler in expression, the deeper in content. (Ito, pp.174,172)

Today, office workers may mention that the view onto the rest of a city or onto an enclosed garden is an important contemplative place for them, right there within the office (Moir, p.38). A similar effect is evoked by certain natural elements. Water and fire are two elements that draw people, no matter where they are located. The crackling sound of fire and the murmurous noise of water attract people's attention away from daily troubles, and with their hypnotic powers make people focus on subtle, everchanging visual and audio patterns, which have relaxing effects and liberate the imagination.

When relaxed in a quiet environment, a person may fully perceive worlds obscured by everyday life, simple worlds of wind, water, light, stones, plants, insects, and other creatures, worlds rarely experienced in our technological environment today.

Living in the city, we have adapted to a highly stimulative environment. As a consequence, we are often no longer able to perceive sensory stimuli that are not strong and aggressive. With our adaptation to a more aggressive man-made environment, we have lost some of our ability to perceive more subtle natural stimuli because they are no longer essential to our way of life. As one of the biological species, "we're given only the sensory information crucial to our survival. . . . Evolution didn't overload us with [other] unnecessary abilities" (Ackerman, p.304). However, as Diane Ackerman has pointed out in A Natural History of the Senses:

Species evolve senses fine-tuned for different programs of survival, and it's impossible to put ourselves into the sensory realm of any other species. We've evolved unique human ways of perceiving the world to cope with the demands of our environment. Physics sets the limits, but biology and natural selection determine where an animal will fall among all the sensory possibilities. When scientists, philosophers, and other commentators speak of the real world, they're talking about a myth, a convenient fiction. The world is a construct the brain builds based on the sensory information it's given, and the information is only a small part of all that's available. We can modify our senses through bat detectors, binoculars, telescopes, and microscopes, broadening that sensory horizon, and there are instruments that allow us to become a kind of sensory predator that natural selection never meant us to be. (Ackerman, pp.303-4)

With all the technical devices present in the world today, we have broadened our possibilities of perception. On the other hand, by using these technical devices, we are increasingly losing the ability to perceive stimuli on our own. The louder the speaker, the fewer environmental sounds we are able to hear; as we adapt to a new level of noise, we hear less. By increasing our tolerance to accomodate a more highly-stimulative environment, we lose some of our ability to perceive more subtle and less aggressive stimuli in the absence of special technical devices to amplify them.

Our ability to perceive is like our other talents: if we do not exercise them, they will not develop. In order fully to achieve our perceptual capabilities, we have to train our senses. As artists and architects, we have a capacity to create environments that appeal to all the senses. However, as architects, today, we are educated to perceive environments primarily in a visual way, as a play of light and shadows, as a composition of volumetric forms, as an interplay of colors. Consequently, our environment has slowly become sensually impoverished, especially with respect to aural and olfactory experiences. The architects of the past paid a great deal of attention to other senses as well. There would be no Gothic without a reverberant sound-effect, essential for a Gothic cathedral, and there would be no Persian paradise garden in which scent was an essential component. By providing stimulation not just for the eyes, but for the other senses as well, architecture can once again make for a sensually rich experience through designs which stimulate the imagination and create a synesthetic environment.

Ackerman argues that "the stimulation of one sense stimulates another." *Synesthesia*, she says "is the technical name, for Greek *syn* (together) + *aisthanesthai* (to perceive)," and she metaphorically describes synesthesia as: "A thick garment of perception [which] is woven thread by overlapping thread" (Ackerman, p.289). Different "senses correspond to each other" and can be translated into one another: "a sound can be translated through a perfume and a perfume through a vision" (Ackerman, p.291). Some people perceive music visually as colors and shapes; others may hear the play of light and shadows on the walls of architectural structures. The symbolists'[20] essential belief was that all arts are parallel translations of one fundamental mystery. Not only the arts but also our own experience suggests that the aromatic smell of coffee can be associated, for example, with grandma's kitchen and that the old parts of the city can bring back memories of past events and people.

To design environments that appeal to all the senses, an artist/architect should employ knowledge derived from various disciplines. It is not enough to use metaphorical expression; a designer should work as a scientist with an engineer's accuracy, and use a knowledge of acoustics, fluid mechanics, and optics, as well as information drawn from botany, zoology, anthropology, and

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[20] The word symbol derives from the Greek word *symballein* (to throw together).

other disciplines.

Creating special environments that stimulate all the senses and, at the same time, provide a kind of contemplative place for people to explore different levels of the physical world is a necessity in contemporary cities. We can learn a lot from past cultures, especially from Persia and its Muslim successor. These culture's particular attention to the creation of architecture that would appeal to all the senses. The following chapters list numerous examples of architectural environments from various cultures that appeal not only to the visual, but to the other senses as well.

PART 2 - NATURE AS AN ARTISTIC MEDIUM IN ARCHITECTURE

SUNLIGHT

I have an interest in the invisible light,
the light perceptible only in the mind . . .
I want to address the light that we see in dreams. . . .
                                    James Turrell

Light is one of the most important life-giving natural phenomena and one of the most persistent of sacred and religious metaphors in almost all cultures. Since it enables us to see the three-dimensional world around us, it plays an essential role in architecture. The manipulation of light and shadow has been a primary interest of religious architecture throughout history, and ranges from time structures in Ancient Egyptian and design of columns in Greek architecture to the stained-glass windows of medieval cathedrals. However, as a result of innovations in contemporary technology, the ability to use natural light in a number of different, creative ways has expanded.

In nature, sunlight can be experienced as the pure play of light, shadows, and reflections. It can be experienced as the whole spectrum of sunlight in a rainbow or as a polar glow. Even though the basic manipulation of sunlight in architecture concerns the creative use of shadows, we can also use other properties of light in order to diversify our experience of light. We can use prisms, diffraction-grating materials, different kinds of filters, and dichroic glass in order to split light into its spectral components. We can manipulate the surface of objects to change the objects' appearance or to reflect light in special ways, which may add some additional kinetic qualities to the created experience.

Manipulation of light and shadows to emphasize the three-dimensional qualities of a space or an object is the most common use of light in architecture and sculpture. The Greek temple cannot be imagined without the bold interplay of light and shadows to which ancient Greeks paid so much attention. Information about the surface of an object or space is conveyed by the character of the transition between light and dark: a sharp transition from

light to shadow indicates a planar surface; a gradual transition suggests a curved surface. Therefore, a sharp transition between the illuminated and shadowed areas of a non-fluted column's surface flattens a rounded object, and a gradual transition between the two emphasizes its roundness. Architects of antiquity accentuated these qualities of "chiaroscuro" in the Ionic and Corinthian columns with the use of this carefully designed attenuated fluting.

An example from central Turkey shows a rather unique use of light/shadow patterns to form an interesting image. This is the Tac Mihrab portal of the Camisi-Selcuk mosque in Nigde, which dates from the Middle Ages. The design of the portal is abstract and does not follow the Turkish traditional patterns of stone-carving. When the sun reaches a certain height, the shadows cast by the sunlight form a portrait of a young woman. To form such an image, the differences in intensity of the shadows coming from different angles of the surface are essential. The different shades of the shadow that appear according to a certain position of the sun cause a brief daily appearance of the image. Something similar can be found in Chitzen-Itza in Central America. There is a Mayan relief called *Dance of the Snakes* in which once a year the setting sun illuminates only the relief's edges. This quick movement of the setting sun creates an illusion of snakes moving down the walls of the building.

People in Europe as early as the Middle Ages started to use colored glass in order to color light so as to create a special atmosphere, especially in religious buildings. An interesting contemporary example of using colored glass, as well as light/shadow patterns cast on the floor, may be found in a work by Otto Piene at the University of Constanze in Germany. This work is a glass roof extending over the main lobby of a student center. Some of its glass elements are colored, so that the light coming through the roof not only casts a geometric pattern of the spatial frame on the floor, but also colors the floor itself. A rather different example of the conscious use of light and shadows and their integration into the composition of the whole structure is Ando Tado's *Chapel Mt. Rokko* in Kobe, Japan, in which a strip of light coming through a narrow opening in the ceiling falls onto the church altar, subtly integrating itself into the composition of the altar.

Besides having aesthetic qualities, shadows can also have important symbolic meanings. In Chinese traditional gardens, for example, garden walls, even though primarily used to give an illusion of a much larger space, have had the important function of capturing the shadows of plants. In Taoist philosophy the shadow of a plant is as important as the plant itself. This is just one of the applications of the Yin-Yang duality. Another manipulation of Yin and Yang in this context is the reflection of an environment onto the surface of water, which leads us to another characteristic of light -- its reflectivity.

A number of artists have used reflected light as an artistic medium. An ingenious manipulation of reflective materials can produce very interesting effects. Such is Dale Eldred's installation (1979) on the facade of the Nelson-Atkins Gallery in Kansas City, Missouri,[21] in which two groups of large yellow mirrors projected sunlight onto the main facade in ever-changing patterns throughout the day.

A different effect using reflection has been achieved by P. K. Hoenich, who creates special reflectors -- sculptural mirrors that reflect amorphic patterns and spread light around upon surrounding environments. His "lightforms" are created by the distortion of light and the ingenious manipulation of reflective and nonreflective portions of the surface textures of his reflectors. Different colors result from the use of different colored filters. While Hoenich uses reflectors and semi-transparent screens to project his kinetic sun-pictures, Janet Saad-Cook has gone further and made highly reflective sculptural forms, themselves interesting as sculptures, to spread varying "sun drawings" throughout interiors. The sculptural materials in her sun drawings are made of mirrored metals and dielectrically coated glass, which selectively reflects light, to produce different colors. Her reflective sculptural structures are minimal in design and small in scale, but the reflected images are large, made of bright colors, and are formally complex. Perhaps her most interesting project is *Sun Drawing*, a work-in-progress for the National Radio Astronomy Observatory's Very Large Array, located on the Plains of San Agustin near Socorro, New Mexico. There she will use the space under a large dome to provide an ever-changing performance of reflected light:

> The building is a hemisphere shape . . . and has a glass-covered opening through which sunlight can enter during the entire year. The reflective sculptures will be positioned on a large elevated platform located along the sun's path inside the building. . . . Visitors will enter a large interior room with a seating area where they can observe the *Sun Drawing* on the interior walls and dome constantly changing in harmony with the sun's cycle. (Saad-Cook, p.157)

The technology of dielectric coating has opened new possibilities in designing light effects. While Saad-Cook uses it to create "mirrors" that reflect different colors, James Carpenter uses it in a slightly different way. He combines the properties of stained-glass, which functions as a color filter that selectively transmits certain frequencies of light, with the properties of a mirror. This contemporary development in optics, combining the properties of mirror and color filter, results in dichroic glass that splits the sunlight into complementary colors. Dichroic glass is glass coated with a microscopic spattering of metal oxides that selectively reflect and transmit different wavelengths. It therefore splits light into patterns that change with the movement of its source, and the glass itself seems to change color as the

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[21] From CAVS archive.

viewer moves. Different from stained-glass windows, which project precise geometric patterns that move with the sun over the floor and walls of a church, Carpenter's windows are transparent, often apparently colorless, and free of imagery, allowing the greatest transmission of light. The three-dimensionality of the windows allows patterns of split light to form an image on the walls and floor that changes over time. This is the image we can see at the Sweeney Chapel of the Christian Theological Seminary in Indianapolis (1987), where the windows are composed of vertical and horizontal panels of glass, which together with a main window-glass, compose a three-dimensional window structure that works as a volumetric wall of glass, splitting the spectrum.

Refraction into the spectrum is another property of light which artists may exploit to create special light atmospheres in architecture. The Barths in the Alhambra, Spain provide a great example that integrates a rainbow effect within the architecture. The effect is achieved simply by placing small holes in the ceiling of the space, which fills with steam as the Bath is in use. The small particles of water act as lenses that refract light and the space fills with spectral colors.

A contemporary example of refraction is a work by the artist Charles Ross, who uses prisms to refract sunlight and fill an interior with large areas of spectral colors. He used this "ongoing theater of the sun"[22] in a proposal for lighting in the temple of Yeshivat Porat Joseph in the Old City of Jerusalem, where the prisms generating the spectra are in skylights around the perimeter of the roof. In the Ross example, the prisms are large so as to produce large sheets of spectral colors. By contrast, Otto Piene's *Pleiades*[23] (1976), on the courtyard wall of the Institute for Astronomy, University of Hawaii, Honolulu, dazzles the eye with a continuous show during the sunlight hours. *Pleiades* is composed of over one hundred and fifty small prisms mounted at the ends of stainless steel rods extending horizontally from the wall. The spectral projections originating from the prisms and the shadows of the rods create constant color and pattern changes in the courtyard, which vary over time and in response to both seasonal changes and the position of the observer.

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[22] "Outside: white sunlight. Inside: a large spectrum advances through the space as the sun passes across the sky. . . . The origins of colors made visible. A constant stream of tiny light quanta with different energy states corresponding to the light of different colors. . . . Intersecting the viewer's experience of the environment with surprise color events, the spectrum commands moments of individual attention, creating incidents of memory in an ongoing theater of the sun." (The Substance of Light, p.6.)

[23] The arrangement of prisms represents the star field of the Pleiades, the Seven Sisters, which is the group of stars that was important in the Polynesian calendar system.

A rather new manipulation of light is the use of holographic diffraction gratings, which change the appearance of a surface according to the position of an observer, as well as varying it throughout the day in relation to the quality of daylight. A good example of this technique was Sally Weber's *Lightscape*,[24] a temporary sculptural installation that used a holographic diffraction grating to project the sun's primary spectrum. The curved structures were illuminated throughout the day as the sun passed in an arc over the site, and the color seen on the surface of the object changed according to the position of the sun and the observer's movement.

While in the previous examples different manipulations of light produced various colors and patterns projected on surfaces, James Turrell explores the perception of light itself (its qualities and its changes as they occur throughout the day), as well as the possibility of manipulating architectural space to capture different qualities of light. Not only does he emphasize these different qualities with a carefully planned architectural space, he creates lightforms that appear so dense that the viewer perceives them as physically volumetric. These perceived volumetric forms of light are made by gathering of light. His work-in-progress, *Roden Crater Project*, which was begun in 1980, will fashion seven spaces in which viewers will be able to experience the changing qualities of sun and moonlight, as well as the interconnections between light and space. Turrell's ambition is to reveal anew the extraordinary physical, symbolic, and psychological properties of light, one of the commonplaces of our lives.

Light is a medium which we cannot live without. Its phenomena, such as shadows, rainbows, and reflections, are so deeply embedded in our everyday experience that we simply do not notice them. However, they may be emphasized and made expressive. Natural light in architecture can be much more than just a medium that helps us define volumetric form. It can project an illusion of volume, such as we find in Turrell's works, or it can be used to create decorative patterns of different colors or even to put on an everlasting performance of light, which changes over time and in accordance with the observer's movement.

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[24] From the CAVS archive.

WATER

The mirror of the pond reflects the shadows;
here is opened an entrance to the mermaid's palace . . .
The moon shines through the willow trees by the pond
when it washes its soul in the clear water.

Yuan Ye

In nearly all religions, water is viewed as the source of life and a means of purification. Water in its tranquil state mirrors the physical world; as a murmuring stream it fills the air with sound. No matter what its state, people are always attracted to water and like to meditate while observing it or simply to enjoy its unlimited possibilities of play.

As a life-giving element, water has been, throughout the history of human society, a resource that has defined the form and location of human settlements. Because of the important role water plays in our lives, all technological advancements were immediately used in water management, as well as reflected in artistic uses of water. At first, artistic uses took advantage only of technologies for harnessing water falling naturally under gravity. Later, the use of water pressure and the development of different powerful jets enabled the construction of amazing water theaters. Electricity led to new possibilities for overcoming gravity and controlling water flow, while today, computers have opened up a range of options for the control of water movement.

The patterns of habitation of all large cultures can be directly correlated to the culture's success in managing water. The first large societies, such as Mesopotamian and Egyptian, developed around the idea of building and managing huge irrigation systems, for which a good organization and coordination of individuals was essential. In these ancient cultures, people built basins and canals and used gravity to fill them up, and animal power to bring water up from deep wells. Even sophisticated Ancient Roman aqueducts depended only on gravity. Not earlier than the beginning of the industrial revolution, animal power was replaced with electrical power, which opened

up completely new possibilities for the distribution of water. Cities expanded in proportion to their water supply and took physical shape related to their water distribution system. For example, Ancient Rome, which depended on aqueducts, was situated in the hills, where the climate is better, while Rome of the Middle Ages, which depended on wells, was situated in the lowlands, even though fog often covered the valleys.

Water-carrying structures related to diverse methods of water retrieval, storage, and distribution were the first inspirations for the artistic use of water. In Mesopotamia, irrigation canals were developed into an archetypal symbol of the four rivers of heaven, later developed into an archetype of the Persian paradise garden. Rectangular mirror-pools in the Egyptian temple gardens also derived from irrigation systems, representing the path through which the soul of a dead person traveled into the eternal world. By contrast, in the Japanese and Chinese garden tradition, water-basins derived from the natural shape of lakes and seashores. Besides their practical use serving as emergency reservoirs in case of fire, water-basins also had an important symbolic meaning. A pool, a mirror, reflecting the environment around it and the sky above it, is, according to Taoist philosophy, one of the representations of Yin and Yang, whereby Yin is the reflection and Yang the material reality.

In contrast to civilizations that developed along large rivers such as the Nile, Euphrates, and Tigris, Hellenic settlements developed around springs of fresh water. In order to preserve their purity, it became necessary to enclose them. The sacred springs soon became focal points in towns and villages. With Roman hydraulic engineering technology, which resulted in the construction of large aqueducts, the importance of city fountains with fresh water expanded. Each of the aqueducts delivered water to a terminal *castellum*, which was a settling tank or distribution point -- where the water from the aqueduct created impressive fountains. The necessity of building fountains at the terminal points of the aqueducts led to the proliferation of city fountains, which became one of the most expressive sculptural forms of ancient Roman cities as the designers used the water pressure to create fantastic displays of jetting water.[25] Much of this knowledge about water management was presented by Sextus Julius Frontinus, the chief commissioner for water in the regions of Nerva and Trayan. He produced a volume of notes called De aquis urbis Romae (97 A.D.) (Morton, p.32) in which he describes the aqueducts, their administration, and the system of distribution of water in Roman cities.[26]

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[25] Marcus Agrippa, probably the greatest fountaineer in history, in one year of his activities in water management, built five hundred fountains throughout ancient Rome and improved the old aqueduct system (Morton, p.38).

[26] The extensive knowledge in hydraulic engineering vanished during the barbarian invasions, and the way to control and circulate immense volumes of water became a mystery for a thousand years. In 1429, this knowledge was rediscovered when the scholar and humanist, Poggio Bracciolini found a copy of De aquis urbis Romae, which meant the beginning of magnificent water structures for Renaissance gardens and piazzas.

Nymphaea, the Hellenistic city fountains, originally dedicated to water spirits, became so popular that many a palace and private house in Rome featured a room full of plants and flowers, where a fountain played or a grotto with running water had been arranged. In Pompeii, we find a number of excellent examples of *nymphaea* integrated within *impluvia*. An impluvium is a small atrium at the entrance of a house, where rainwater from the roof collects and drips from the edges of the roof and falls into a water-mirror below. A water-mirror together with a small splashing fountain and plants compose an interesting ambience that integrates the utilitarian purpose of draining water off a roof with the sacred function of housing domestic gods.

Variations of a fountain fitted with special mechanical devices are also products of the Hellenic Ages; these include a fountain that spouted wine, a water organ, and a fountain decorated with birds that whistled and sang by means of compressed air. The book Pneumatica[27] of Hero of Alexandria shows how ingenious these variations were. In his sketches he shows the use of steam generated in boilers under the temple to cause bronze snakes to hiss, temple doors to open and close, and vessels to spin. In 1580, the ancient Roman fountain called *Pneumatica*, in Tivoli, was still in working condition, providing the technology for the trick and joke fountains of Renaissance and Baroque Italy.

There would be no Renaissance or Baroque garden without the presence of water and water theater. Villa d'Este at Tivoli (1550), planned by Ligorio, an archaeologist and architect who conducted the majority of excavations in ancient Roman sites, revived many of the Hellenistic water tricks. Among the the fountains featuring extravagant water effects are the water organ and the Owl fountain, which has trick fountain jets spurting up from the pavement. Italian fountaineers later on perfected earlier aesthetic achievements with water in Baroque gardens all over Europe, designing some incredible structures, such as the world's longest cascades (1752), in Caserta, Spain, and various water motifs at Versailles.

In modern times, World's Fairs became one of the most important venues for the use of new technology in fountain design. At the New York World's Fair in 1939, there were numerous examples of large-scale water motifs integrated in buildings. Such were the Italian Pavilion, which had a cascaded waterfall integrated in the front facade, and Alexander Calder's *Water Ballet*, a constantly changing fountain of water jets, incorporated into the front facade of the building of the Consolidated Edison Company.

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[27] The ancient technology of Pneumatics has been transmitted to us in a very tangled state; of the three Greek writers, Ctesibios, Philo and Hero, only Hero's work survived in bulk, while the rest survived through the references of later writers. There are some evidences that Hero lived in the first centiry A.D.

In the second half of this century, an interest in bringing water back to the city has increased. Lawrence Halprin, for example, designed several participatory city fountains, such as *Auditorium Forecourt Fountain* and *Lovejoy Plaza and Fountain*, both in Portland, Oregon, in which the public is invited to play in the fountains. An unusual example is a performing sculpture, *Centerbeam*,[28] a collaborative work by the Center for Advanced Visual Studies that was designed as an event for the public to experience water in all of its forms: as water that one can touch and play with; as steam hissing, obscuring the view and providing a screen for a laser display; as ice forming from moisture; and as a prism splitting the light.

In the 1960s and 1970s, steam and ice became interesting media for many artists. "Steam is a phenomenon of the winter city," says Joan Brigham, interested in steam as a human-made element in addition to its presence in nature as clouds:

> It issues from virtually every opening: man-hole covers, grates, roof vents and chimneys. The cities of the Northeast seem to be "cooking:" Canal Street in New York looks like a geyser field in Yellowstone. Oddly, most people do not notice these eruptions, even when the surging steam temporarily blinds them. (Brigham, p.43)

She uses the term "urban geyser" as a kind of metaphor for her sculptures. In her view, steam is a source of mechanical energy that performs work by exerting pressure. In nature, very hot water, under huge amounts of pressure, erupts from the earth in the form of steam. Brigham's fountains do basically the same thing: they release steam, which is thus used artistically. The most poetic among her year-round fountains is probably the *Tanner Fountain* at Harvard University on which she collaborated with the landscape architect Peter Walker. Both the water and the steam at the fountain were carefully designed to produce the same effect -- a cloud hovering over the stones.

Brigham's *Steamshuffle*, designed in collaboration with Christopher Janney, is a temporary installation using steam, plexiglass plates, and poetry. In the installation, Brigham takes advantage of the properties of condensation in relation to temperature. Her intention is to achieve an effect similar to writing with a finger on steamed glass. When steam hits the cold glass plate, it mists up, revealing only the letters of the poem, which, because of the surface treatment of the glass, remain transparent. Wind that carries steam is an additional factor that affects the appearance and disappearance of portions of the poem, giving the piece a kinetic quality.

Ice is another neglected form of water with great artistic potential. The effect created by allowing fountains to build up ice mounds of ever-changing size and shape can be truly magical and should be considered in colder climates.

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[28] Exhibited on Documenta 6 (1977) in Kassel, Germany, and in 1978 in the National Mall in Washington, D.C.

Norwegian artist Carl Nesjar uses ice as part of his all-year fountains, which are water fountains in summer and growing ice sculptures in winter. In the winter, he uses warm water to keep it from freezing in the pipes; however, the water is cold enough not to melt the growing ice sculpture.

With the advent of computers, the possibilities for controlling water movement have greatly expanded. In The Avenue at Tower City in Cleveland, Ohio, the architects from RTKL, Dallas, Texas, together with WET Design from Universal City, California, designed an interesting piece, *Skylight Concourse Fountain* (1990). Using highly sensitive valves and computer control of water pressure and water movement, they created an ongoing theater of jumping cylinders of water. The fountain consists of a plane with an irregular distribution of small holes embedded with highly sophisticated water jets. A computer controls the movement of water in such a way that an illusion of a jumping cylinder of water is created, which jumps from one hole to another such that the water appears to be alive. In a certain way, giving water an unnatural appearance denaturalizes it; however, an ingenious manipulation of water movement by controlling its pressure and its exact path reveals a different side of water -- it shows the physical characteristics of water surface tension.

Today, while still preoccupied with water resources, our concern in water management does not relate just to the storing and distributing of water, but also to its purification and recycling. There are a lot of possibilities for using different kinds of plants to purify water biologically. Large basins of water with these kind of plants may become a focal point of a neighborhood. A good example of this kind of approach is Viet Ngo's artistic transformation of a water purification plant in Gorg, Italy. In many cases, contemporary industrial production requires large quantities of water for cooling. This water cooling system can be transformed into a visually attractive fountain that cools the water before it is reused.

Flood protection, another form of water management, can also be an interesting challenge for designers. A good example of this is Herbert Bayer's *Mill Creek Canyon Park* (1982) in Kent, Washington, which combines the solution to a troublesome flood-water problem with the land art. Carefully designed circular basins in the park, used for enjoyment, are capable of holding 460,000 cubic feet of water, and they fill during flood conditions.

In our every day life, there are many devices for managing water that give us various possibilities for transforming them into artistic artifacts. Besides the most obvious ones, drinking fountains, we can use rain water and use it in an artistic way indoors or outdoors. Rain water usually goes directly into a sewage system, but it can be artistically used to form waterfalls, cascades, etc. We must completely revise the thinking of the modern designer for whom rain represents just a necessary evil she/he has to deal with. Why not gather rain water and use it creatively in waterfalls, flooded windows, spouts, or

make it softly whistle to mark the rainy season. Why not design a wall integrated within the structure of a building that can be an interesting sculptural piece in itself, but when it rains it becomes a waterfall? Why not, in areas with a cold climate build special structures to control the position of ice candle formations, which can be framed within interesting views and experienced visually from indoors or outdoors? Why cannot steam, used as part of a heating system, be released to give an opportunity to experience a cloud or mist on a sunny day? Why can an irrigation system in the fields or a cooling system for industrial water not become an ongoing water theater? All these are some of the numerous possibilities we may choose and use artistically.

SOUND

There is no quiet place in the white man's cities.
No place to hear the unfurling of leaves in the spring
or the rustle of an insect's wings.

Chief Seattle

Sound used to be an important way of receiving information from the environment; however, as Murray Schafer points out:

> In the West, the ear gave way to the eye as the most important
> gatherer of information about the time of the Renaissance, with
> the development of the printing press and perspective painting.
> (Schafer, 1977, p.10)

Consequently, architects stopped using their ears in designing architectural spaces, which to a large degree has diminished the experiential potential of newly designed environments.

Geography, climate, and culture are the vernacular notes that make up the soundscape in each part of the world.[29] Not only does the soundscape of a village differ from that of a city, but a walk through a forest in the icy North provides us with a sound experience different from that of a walk through an equatorial rainforest. A pine forest itself differs in sound from a foliage forest, because the needles vibrate in a different way from foliage. But, because we live in crowded cities, and because we have filled our environment with mechanical noises, we rarely have an opportunity to experience such differences. When people lived mostly in isolation or in small communities, their ears operated with seismographic delicacy. In a rural soundscape, sounds are generally uncrowded, surrounded by pools of stillness. In such a soundscape, even the slightest disturbance can communicate interesting or vital information. A shepherd, for instance, can

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[29] Some detailed studies of different soundscapes: Schafer, Murray R. (Ed.), Five village soundscapes, A. R. C. Publications, Vancouver, 1977; and Schafer, Murray R. (Ed.), The Vancouver soundscape, A. R. C. Publications, Vancouver, 1978.

determine the precise state of his/her flock just by listening to sheep bells. An exceptional ringing is fast and it has a different rhythm; if the ringing is irregular, it means the flock has broken into a new pasture, and if it is regular, it means that the flock is running from danger. However, most of the information we consider vital today we receive through telecommunication systems, which has taken us away from directly gathering information from nature.

Sound was also an important element in building human settlements. The size of an ideal community in the time of Aristotle was somewhere around 5,000 inhabitants, which is the size of a community that one person can address with one's naked voice. The human voice was crucial to Islamic communities, while the church bell defined the Christian acoustic community. An interesting example of "acoustic farms," where houses were placed within shouting distance from one another in case of surprise attack, is provided by the early North American settlers (Schafer, 1977, p.215). Today, however, modern telecommunication systems, especially radio, enable us to increase the power of a human voice almost to infinity. The consequence is that a modern acoustic community can be the whole world.

As already pointed out, the early builders built with the ear as well as with the eye. The result is the exceptional acoustics of Greek amphitheaters where, if empty, the sound of a pin dropping can be heard distinctly from each of the seats. The reverberation time in these theaters was never more than a few tenths of a second (Schafer, 1977, p.219). In his fifth book, Vitruvius discusses the employment of sounding vases in theaters to enhance sound production. The sounding vases were what we now call Helmholtz resonators. They appear to have been widely used throughout Europe and Asia. A very good example is a small fifteenth-century abbey church at Pleterje in Slovenia, which has fifty-seven sounding vases. "The double resonance system employed in this case resulted in a high absorption over a broad frequency band from 80 to 240 hertz, an area in which the reverberation time in brick chapels is normally much too long" (Schafer, 1977, p.222). A contemporary example of incorporating large Helmholtz resonators in the walls of a concert hall is the Opera House in Sydney (Schafer 1977, p.224), which successfully employed this ancient technique.

While in the Greek theater a human voice is clear and can be articulated as quickly as desired, in the Gothic cathedral a voice gets unusual modulation and speech has to be slowed down. Reverberation and echo give the illusion of permanence to sound, and convert the sequential tones of melody into the simultaneously heard chords of harmony. The reverberation time in the Gothic church goes up to 6-8 seconds (Schafer, 1977, p.219), and converts a normal voice into monumental, angelic singing. Another "echo effect" can be experienced in the Shah Abbas Mosque in Isfahan (1640 A.D.). By standing directly under the apex of the main cupola, we can perfectly hear the famous sevenfold echo; standing a foot to either side, we hear nothing (Schafer, 1977,

pp.219-221). These sound effects are related to the form and size of an architectural structure; however, there are a number of other sound effects that make the experience of any environment richer.

There are several possibilities for designing environmental sound structures. Our global cultural heritage includes many different kinds of simple sound-making devices (wind chimes, bells) that can be easily adopted by designers and turned into artistic objects that can be integrated within the context of buildings and urban structures. These can enrich our experience of nature, make beautiful sounds, or simply provide a pleasant white noise.

The "Persian garden of paradise" was a feast for all the senses. Besides attracting song-birds and other singing creatures to their gardens, people very early employed all kinds of sound mechanisms. Some used water and some wind to trigger sound. Hero of Alexandria described some of the ancient mechanisms that were made to produce sound by forcing a stream of air into a sound-sculpture by water pressure. His water organ and singing birds realized in the *Pneumatica* used such mechanisms. These sound structures were revived at the Villa d'Este in Tivoli near Rome, which has some of the most attractive water fountains found in Renaissance gardens.

Many artists, such as the brothers Baschet and Harry Bertoia, have carried on this interest in musical water fountains. Bertoia in his musical water fountains used membrane-like metal surfaces, usually made of copper tubes welded together with bronze. Water plays onto the surface of the sculpture from different jets, resonating the air inside the tubes, and acoustically amplifying the movement of water.

Another way to trigger sound-making structures is by using wind. Bertoia's wind-triggered sound sculptures are made of thin rods of different metals. The rods are connected only at their base, so when the wind moves them against each other they produce deep reverberating sounds, like those of many bells. Different metals, different lengths, different thicknesses, and differently shaped rod endings produce different sounds. An untitled bronze sculpture in the collection of Mr. and Mrs. Irving Castle, for example, "reverberates for a long time, setting up a strange cacophony as of ocean waves crashing and receding in a metal cave" (Nelson, p.42).

An historic example of a wind triggered sound-making structure is the Aeolian harp, widely used in Germany during the Romantic era. Its origins are probably Chinese, where it was incorporated into the design of certain kites. In the Aeolian harp, the resonance of the wires triggered by the wind gets enhanced by an amplifier, which can take different physical forms. In recent years, Christopher Janney has made a number of musical environmental installations of large-scale Aeolian harps that were integrated into urban spaces. Bill Fontana turned an existing architectural structure, the Golden Gate Bridge in San Francisco, into a harp. Using microphones, he

produced amplified sound in front of the San Francisco Museum of Modern Art in 1987.

The Baschet brothers use both principles, the water organ and the Aeolian harp, to trigger their sound sculptures. In their watermills,[30] for example, the public is invited to play with the water valves to produce different sounds. Another example of using sound in the environment is Luis Frangella's *Rain Music*, (Grayson, pp.183-5) a project in which he used a series of drums arranged in the shape of a roof to be placed in a quiet section of a city. The moving elements mounted above the drums transform the impact of rain drops or the movement of the wind into kinetic energy, causing the elements to strike the tuned drums with varying amounts of force.

Throughout history, people have listened to the sounds of nature, and they have used many different devices to transform movement into sound in order to gather information or simply to enjoy. Because of sound pollution today, we are rarely able to hear pure natural sounds. As noted by Schafer, up until the present century, church bells and sirens were probably the loudest man-made sound heard in the community.

> The internal combustion engine now provides the fundamental
> sound of contemporary civilization. It is the keynote, as surely
> as water was the keynote of thalassocratic civilization, and the
> wind is the keynote of the steppes. (Schafer 1973, p.13)

Traditionally, the motor symbolized power and progress, and for most people noise and power went hand in hand. Up until the seventies, machines that operated quietly were less impressive than noisy ones. However, in October 1969 a community of musicians at UNESCO declared the right of everyone to silence (Schafer 1973, p.32). Therefore, it is not a coincidence that a lot of avant-garde artists' work today deals with silence, providing a listener with the experience of simple, pure, natural sounds. The "musique concrete's" idea that music can be made from natural sounds gathered in the environment, and John Cage's silence as integral a part of the whole musical piece as sound itself, have influenced many artists. Minenko Grimmer, for example, has used natural sounds and silence in her installations:[31] she let pyramids of small polished stones frozen in ice melt, and on their way through the air they hit different materials, such as bamboo, water, and stone, to make contemplative sounds.

By contrast, Christopher Janney, an architect and jazz musician, at Miami's Muracle Center juxtaposed a high-tech environment with a musical score made up of a mixture of bird songs, the sounds of flowing water, and synthesized voices. These sounds taken from nature play within a high-tech environment of four glass elevators, creating ever-shifting patterns of colored light that reflect off an 8,000 square-foot curved mirrored wall as they move

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[30] One of their installations was exhibited at Hemisfair in 1969 in San Antonio, Texas.

[31] *Seeking the Philosopher's Stone*, 1985; *Symposium*, 1987; (Davis, pp.54-57)

up and down the nine story building. However, this musical score, made up of a mixture of natural sounds, constantly reminds the listener of the nature that she/he so rarely experiences in a contemporary city.

Some of Janney's other projects illustrate the wide potential the technology of synthesized sounds offer architects today. His projects range from his sound stairs (*Soundstairs*, 1973) and sound passages (*Winds of Sound*, 1992) to musical piazzas (*Sonic Forest*, 1992), where people trigger environmental sounds with their movement, interacting with the place to "compose" environmental music. The principle is that when they move, people activate special sensors that are connected to a computer with digitally stored environmental sounds and a synthesizer that transforms digital information into sound that can be played through speakers within the environment.

Evidently, there are many ways to make any environment acoustically richer and more pleasant. They range from employing very simple acoustic effects to highly sophisticated high-tech devices. However, the important question today is not so much how to make a sound, but how to provide silence such that desired sounds can be heard. Often, today, music is used to mask noise, and oddly, noise is used to mask music. If a masking noise is continuous and not too loud, and if it has no informational content, it becomes an acceptable background, buffering other noises, and making the noise level appear psychologically quieter. A well-known practice today to mask noice, speech, the sound of squeaking chairs, walking, etc., is to add "white noise," which can be a water fountain in public places, music in shopping centers, or mechanical noise in business buildings. However, in order to provide the possibility of hearing the "speech of nature," some spaces have to be designed to provide silence by using different sound-absorptive materials, or by carefully planned locations (sunken gardens, atriums, etc.), because masking the sound of an environment with white noise, unfortunately, overwhelms those natural sounds we would like to hear.

SMELL

The scents of plants are like unseen ghosts.
They sneak up on you as you round a turn in the garden,
before you can see the plant from which they came.
                                        Barbara Damrosch

Creating architectural environments, we often forget about the importance of odors. Firstly, because architecture itself is predominantly visual, and secondly, because in our culture we pay more attention to odorlessness than to nice scents. However, this was not always the case. People in the past paid much attention to smell, and as contemporary research in psychology shows, smell can play a significant role in creating pleasant, or sometimes special environments.

Research in the psychology of fragrance shows that the olfactory sense plays an important role in retrieving memories (Kilmartin). It can recall memories better than any other sense. This is due to the way odors affect the brain. The olfactory system is directly connected to the limbic system, which controls emotional reactions and sends the response to the body. The first reaction to an odor is subconscious and immediate, while the conscious reaction is secondary. This is what makes odors so powerful in making associations and in retrieving memories. Therefore, the conscious use of odors can be an important tool in creating special atmospheres within various environments.

The importance of odors was well known in the ancient world, when people were respectful of the mysteries of scents. A lot of rituals, especially religious rituals, were connected with their use. The ancient Egyptians, for example, buried their dead among treasure and vials of perfume; the ancient Greeks and Romans burned incense and sent sacred odors heavenward to reach their gods. The Japanese had a scent ceremony, *kodo* (McCartney, pp.140-143), which is still alive in some monasteries. In the *kodo* ceremony, which has some similarity to the tea ceremony, participants are given a number of different scents to smell and describe. The ancient world had a rich tradition of using

scent not only in rituals, but also in everyday life. People used them to protect themselves and their wealth from various insects,[32] they used them to mask some unpleasant odors, and they simply enjoyed pleasant scents, letting the aroma take them away into the world of imagination.

A rather unique use of fragrance is its use in marking time:

> [The Japanese] invented an ingenious incense-'clock' (Koban-Dokei), which made it possible to 'smell' the time. In this instrument, small tablets of incense . . . were burned down in succession, one by one. Since each tablet emitted a different aroma, people with sensitive noses could tell the approximate time. (McCartney, p.142)

Islam provides us with some of the most interesting historic examples of olfactory spaces. The mosque at Kara Amed and the mosque of Zobiade at Taris were built with musk[33] mixed in the mortar. In both mosques the musk fragrance can still be detected by people with trained noses. Musk is a particularly important perfume to the Muslims. Due to its ability to last for a long time, it was a perfect element to define the special atmosphere of the mosque, as well as to mark a house of God, since in Paradise, perfumes never fade. Similarly, in the Buddhist tradition people carefully choose fragrant timber to build temples. In contrast to India, Japan is poor in fragrant timber; therefore, the timber for temples was often shipped from abroad.

Although people have tried to integrate scent into architectural structures in many different ways, live blossoms provide the most natural aromas. In the history of gardens, the "Persian paradise garden" was the one that had to appeal to all senses. Thus, the use of flowers that are "rare to the eye, sweet to the smell and useful in physic" (Jellicoe, p.38) were very important. The famous Court of the Myrtles in Alhambra, for example, has a strong scent identity. The Court is composed of a wide water canal in the middle, and two lines of trimmed myrtle bushes on both sides. However simple in design, the smell of the myrtle blossoms as well as their leaves give the garden a rich and ravishing scent and define its identity.

The archetype of the square "Persian paradise garden," which was adopted and further developed in Islamic culture, was later transmuted into the contemplative cloister garden of the Christian monastery. As a Middle Ages cloister garden, it kept some of the fragrant elements, such as rosarios and flower beds, but these were almost completely lost during the Renaissance.

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[32] Lavandula officinalis is a plant used in many Mediteranean countries to protect wool from cloth-moths.

[33] Musk is the dried secretion from preputial follicles of the northern Asian, small, hornless deer, which has musk in its glands.

Oddly enough, modem gardens have become increasingly scentless. Scent gave way to shape. A selection of bigger, hardier, more-petaled flowers has become the goal of the hybridizers, and while the new plants are often superior in many ways to the old favorites, they are rarely more fragrant. As Barbara Damrosch says:

> Scent is a ghost you find in old gardens. It is also found aplenty in gardens for the blind, who are particularly attuned to scent, and in herb beds where the subtle scents of foliage are treasured. A garden planted for fragrance is thus an unusual creation. (Damrosch, pp.25-26)

If memories are unavoidable when confronted with the right odor trigger, why then do we not use natural scents to make nature more visible, more present to a contemporary urban citizen? With a conscious and wise use of fragrant plants[34] one can create fragrant gardens and fragrant urban plazas, which would provide people with unforgettable experiences of nature.

Yet, the notion of the importance of smell has not disappeared, and it even became an important commercial tool. That a food store where one can smell freshly baked bread is much more inviting than other food stores was recognized by grocers. Many grocery stores have the air from the bakery or deli department pumped to the front of the store, welcoming the customer and confirming that this is a place to get food. A smell gives identity to a place as well as communicates the quality. This is also recognized by industry.

> Soap, cosmetics, cars, computers, tobacco, and food are all odoured to give identity and make the product more pleasant. There is much testing to give a product an odour that is both pleasing and tells the consumer that it is doing the job. (Van Toller and Dodd, p.29)

Masking unpleasant environmental smells deriving from waste-plants, farms, zoos, as well as from man-made materials we use today in a building's construction, and making the environment more palatable and pleasant to people, is an important way of using odors today. Most of these odors are designed to neutralize bad smells by approximating scentlessness. A successful case of this kind is the Franklin Park Zoo in Boston, where strong smells of various animals are successfully masked. However, there is still much research that must be done in the area of synthetic materials used in interiors today. These synthetic materials vary from wall paints and carpet glues to furniture that sometimes represent a problem for a number of visitors.

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[34] Some of the fragrant plants that can be used in city parks: *Tilia sp., Rosa sp. climbers, Syringa vulgaris, Galium odoratum, Philadelphus sp., Viola odorata, Clematis paniculata, Rosmarinus officinalis, Lavandula officinalis.*

In the last few decades, a number of artists have used odors in various ways. Artist Joseph Beuys, for example, made a poetic call for world peace through his work *Lavender Filter*[35] (1965). In his sculpture *Tallow* (1977), which was meant to be a symbolic salve on the wounds of urban development, he questioned the underlying motives that produce urban concrete deserts. Katharina Fritch used strong perfumes in her installation *Parfum 1984* to question the suppression of women in contemporary society. The Center for Advanced Visual Studies did an installation *Dialogue of the senses*, which was designed for the sensory impaired, in particular the blind. However, here scents are used in symbolic ways, to pose political questions or to make people aware of olfaction as an important, and in our society often neglected, sense.

Whether in landscaping, public space design, or commercial enterprises, odors can be used as a creative tool by an artist or an architect. Keeping in mind special smell effects, while creating a space, and employing smell design in an early stage of environmental design may have interesting positive results that will enrich our sensory experience of our living environments.

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[35] The work consists of a circular gauze pad under the cone shaped filter, with lavander oil passing through the cone. Since lavender (*Lavandula officinalis*) is an odour that calms the smeller, the filtering of the lavender oil serves as a metaphor for the spiritual quality of calmness. The gauze pad is a visual metaphor for an absorbent bandage on a wound, and its circularity represents wholeness and the earth. Therefore, the calming effect in conjunction with the dripping oil symbolise spreading peace over the world and the healing of wounds.

VIEW

We shape clay into an urn.
It is the empty void that makes it useful.
We form doors and windows for a house.
It is through these empty voids that the house becomes useful.

Lao Tze[36]

In the very nature of human beings there is a need to see and control our surroundings. Satisfying this need provides us with a feeling of security. Once people had to be able to see and control everything with their own eyes, however, in contemporary technological society, the functional component of "seeing" has changed, since we "see" and control our environment through different kinds of electronic devices. Besides security, there were also aesthetic as well as contemplative reasons that led people throughout history to be careful about choosing the site, as well as about designing the environment, to preserve interesting views of the surroundings.

In Western cultural tradition, the placement of a building on an elevated site in order to get wide panoramic views is one of the basic rules of good design, affirmed by Vitruvius and later by Alberti. Designers of Renaissance and Baroque villas were satisfied with panoramic views for their own sake; by contrast, builders of Chinese and Japanese gardens made the view an integral part of a garden, using the technique of *shakkei* (Hayakawa, pp.140-142), or borrowed-scenery, which became perfected in Japanese garden design roughly at the beginning of the seventeenth century. Chinese writer Li Chi-cheng produced a manual of garden design, called Yuan-yeh, in which he divided the technique of borrowing scenery into four categories: borrowing from a distance, borrowing from nearby, borrowing from a high angle, and borrowing from a low angle. Borrowed-scenery is the idea of borrowing panoramic views of distant hills, mountains, cities, villages, and integrating them into the design of a garden, or borrowing garden views and integrating them within the interior of the house.

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[36] Translation by Chung Wah Nan.

The principle of perspective was the cohesive force which kept together the structure of a Baroque garden, and the axis was the device through which man was able to reach for infinity. "L'etat, c'est moi!", said Louis XIV, whose absolute power is symbolized in the structure of Versailles and axial interventions in the structure of the city of Paris. However, that was an expression of a human wish to govern nature, so common to Western man. In contrast, the Eastern principle of borrowed-scenery made a garden a part of the distant natural environment in order to allow a person to commune with nature, which is one of the ends of Taoist philosophy. The principle of borrowed-scenery was to frame an interesting view with the careful design and placement of compositional elements of a garden and a house in such a way that, visually, a garden naturally continued into a landscape, or that the interesting view became a focal point within the building.

The most magnificent examples of borrowed-scenery designs in Japanese tradition are the upper garden of Shugaku-in villa, and Entsu-ji temple, both in Kyoto. The first so integrates a wonderful view of the hills and mountains into the garden that they seem to be part of it, while the second garden, a very small one, integrates the view of the mountain using the technique of gradation from man-made to natural. In front of the house stand trimmed bushes (okarikomi), in front of these are trees in their natural form, and in the distance the view of the mountain. This technique was adopted in Frank Lloyd Wright's Prairie Houses, among which the Robie House is the most obvious example. There the view spreads from an interior through the abstraction of nature in vitrage-windows (abstractions of prairie flowers and plants), to managed nature in the balcony window boxes or big concrete vases and further out to the garden, and finally to the wilderness.[37]

In both Chinese and Japanese tradition, some gardens are "viewed primarily like a painting, from several fixed positions" (Slawson, pp.80). These are called "scroll gardens." They "may be compared to a landscape scroll being unrolled horizontally before the eyes of a seated observer" (Slawson, pp.81). One need not physically enter these gardens in order to partake of their pleasures. Such are particularly Japanese dry Zen gardens, which were exclusively meant to be experienced visually without physically entering them. In some there are special, carefully designed patterns in gravel, which one cannot walk on. They are meant for observation and contemplation.

However, this uncovers another aspect of the principle of borrowed-scenery and framing. The predominantly warm climate and extremely open wooden post-and-beam structure of Eastern architecture allowed the organic unity of architecture and garden, contrary to the Westerner's opposition between the two. Using techniques of borrowed-scenery and framing, a garden looks like a framed painting on the wall of the room, changing over time. Therefore, to invite perception of the garden's scenic views through windows, doorways

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[37] At the time the house was built, the view still spread out into the wilderness.

and other apertures, the desired views have to be thought out in advance. The predominantly architectural framework of buildings and (especially in the classical Chinese garden) garden walls with a lot of openings, giving the illusion of much larger space, can make a garden into a "multi-dimensional painting in space and time" (Engel, p.5).

The principles of borrowing scenery and framing could be a very efficient tool in design today as well. The principle of framing and leading the attention of an observer to certain natural features (such as plants, trees, ice-candles or magnificent views of different landscapes) gives a designer the opportunity to control and create both the window and a view. At the same time, this kind of framing can provide much more opportunity for people to notice the simple world around us, to which we, because of the extreme speed of our life style, increasingly pay less attention. It is hard to notice a rock among a number of rocks, but the rock placed on a pedestal, as we find it in a Chinese garden, attracts attention. It is the same with flowers or any element in a garden. If our attention in creating the view of a garden ends with curtains and the glimpse of a garden, we have a completely different effect than if we carefully arrange all the garden elements in such a way that we create an interesting, well balanced, and well framed view. Such a view itself becomes an artistic object, and therefore, attracts more attention.

NATURAL CYCLES

The sculpture is a strategy
for people to see nature.
                    Patricia Johanson

We live in a period of global ecological crisis which knows no international borders. Radioactive wastes, poisonous industrial smoke, car emissions, chemical fertilizers -- all these destroy the ecological balance in nature. The depletion of the ozone layer, the greenhouse effect, the destruction of the rain forest, the pollution of the air, water and soil threaten our very existence. We are fighting a war against ourselves. Our survival depends only on how fast we will realize that we are not the masters of nature, but merely one part of it. To make us aware of our dependence on the natural world around us, it is of great importance that we incorporate some elements of natural life cycles within our built environment, which will give us insight into environmental problems and perhaps change our attitude toward nature.

"Nature is a gardener's best designer," says McHarg, who argues for using ecological knowledge of natural systems to manage the land. Parallel to the notion of ecological planning, some artists, such as Alan Sonfist, have started to use natural cycles as the media for their artistic work. While McHarg challenges landscape architects and city planners to adopt "the natural processes as values" (which have to be considered in the overall urban planning process), Alan Sonfist addresses the public with his idea of "natural phenomena as public monuments," an idea that suggests dedicating civic monuments to nature and questions the essential cultural values of contemporary society.

To allow the viewer to experience the decomposition of leaves into earth, Sonfist created *Tower of Leaves* (1976-77) in which fallen leaves, stacked up between four steel columns and arranged in a tower, were left to compost. Other ecological artworks of his are *Seed Catcher* (1973) and its variation,

Pool of Earth (1975). The latter was done in Artpark, Lewiston, New York, where Sonfist cleared a circle of land of chemical waste, brought in new earth, surrounded it by a ring of rocks, and waited to catch drifting seeds to begin the rebirth of a forest. While Sonfist emphasizes natural cycles, a German conceptual artist, Hans Haacke, stresses the importance of human action in maintaining land. Dealing with cycles of pollution and purification, he installed *Rhine Water Purification Plant* (1972) in the Museum Haus Lange in Krefeld, West Germany. Haacke brought water from the polluted Rhine and exhibited its gradual purification in a gallery, where water passed through chemicals, sand, and charcoal filters into a large enclosure containing live goldfish in totally clean water: life had returned to the Rhine.

While these artworks deal with processes occurring in real time, Sonfist also focuses on long-term natural changes. Examples are found in his *Time Landscapes* and *Circles of Time*. In *Time Landscape* (1978) he "recreated" a pre-Colonial forest in Red Hook, Brooklyn. His *Circles of Time* in Toscana, Italy, shows how the Greeks affected the land through their cultivation; each circle represents a certain time in the historic progression from natural landscape to the cultivated land of today. Such art cannot really recreate the ecosystem that was lost. What it can do, however, is to bring down, through visual representation, vast natural changes to a human scale and to generate and magnify urban concern. Artists, through metaphor and decomposition, emphasize chosen aspects of life cycles and make them visible, comprehensible, and easily communicable to a broader public. The aesthetic of ecological art, therefore, increases the public's awareness and involves an artist in the lofty challenge of saving "Mother Earth" and her child -- the human race.

The knowledge provided by the natural sciences is the great advantage we have today: it enables us to become "creators of life." By knowing the functioning of all the parts of an ecosystem and their interconnections, we can create not only symbolic representations of an ecosystem, but a "living being" -- an ecosystem itself. Such knowledge enable us to manipulate the parameters of an ecosystem so as to create living outdoor environments that attract particular living creatures that provide us with desired visual and sound effects. An example would be an outdoor butterfly garden with the presence of flying butterflies as the created special effect, or a frog garden in which the sound of frogs is heard. Such human-made "natural" environments are *design with nature*, in contrast to *design in nature*, in which form and color overlay a natural system.

For many reasons people in our agricultural past "domesticated" various wild birds. Enjoying the music of songbirds, people have always tried to lure them with food. Because they fertilized the earth with their excrement, pigeons were favored in Capadocia, central Turkey; the people built special structures in the fields to feed them. In Europe, people "domesticated" swallows, which nested inside the stables on old farms. They were useful in a hygienic sense:

they ate the insects that preyed on the farm animals. Migratory birds keep returning to the same nest throughout their entire lives. The modern life-style of cities took away many of the opportunities for them to nest. Ecologists in the small German town of Erlangen, however, decided to bring them back. The architects designed special permanent structures on the walls of houses, just below roof-level, which attract swallows. They return yearly to the town and signify the changing of the seasons.

Similarly, Wyoming ecological artist Lynne Hull, who works for that state's Game and Fish Department, has created colorful sculpted habitats for wild birds to nest. The primary role of these habitats is not to attract critical attention, but wild birds. She said that her work is "not about being a decorator for ducks," but about designing birds' habitats to make them "attractive enough that people can enjoy and learn from them" (Cembalest, p.102). Such work illustrates exactly what landscape architect Ian McHarg claimed twenty years ago: "natural processes can be constructed as values in such a way as to permit a rational response to a social value system" (McHarg, p.31).

In Florida, there are gardens designed to attract hummingbirds which, as Barbara Damrosch puts it, "have a sweet tooth." She continues:

> Although a large part of their food consists of tiny spiders and
> aphids, they also crave the sweet nectar of flowers the way
> children crave candy, and they will feed on almost any flower
> that has an ample supply. (Damrosch, pp.148-158)

Given a choice, hummingbirds will gorge on tubular- or trumpet-shaped flowers of bright red and orange colors,[38] which are therefore typically used to create such gardens.

Birds are not the only wild creatures which can be attracted to human-made environments to live in. As was already mentioned, there are also butterfly gardens, such as the one at the University of Florida. Some gardens attract more butterflies than others, usually because they contain more flowers that are rich in the nectar that butterflies drink, and also because there are more plants in the area on which butterfly caterpillars feed. By choosing the right plants to introduce in a garden it is possible to create an environment where people are able to observe the whole butterfly life cycle in an outdoor environment, rather than an artificial environment like that of a zoo.

To plan an environment in which particular animal species can thrive, one should understand their needs during their entire life cycle. Thus, the needs of caterpillars, usually regarded as bad bugs, should be taken into consideration as well as the needs of the butterflies they turn into. The captillars of the swallowtail butterflies (*Pterourus glaucus* and *Pterourus multicaudatus*), for

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[38] Such are *Campsis radicans, Rododendron sp., Weigela florida, Chaenomeles japonica, Lilium sp., Hibiscus sp.*

example, feed on cherry trees (*Prunus sp.*); in the butterfly form, they are attracted to lilac (*Syringa vulgaris*) (Damrosch, pp.53-66). Moreover, the life environment of these creatures should not be a "pedigreed lawn" with cherry trees and lilacs. They like an environment containing some of the most common weeds. Muddy puddles of stagnant water are important to them, as well as dead plants and decaying fruit. This environment might sound a bit unpleasant, but if one takes into account the whole ecosystem, one can find ways to design pleasant environments for both, butterflies and people.

By observing butterflies in a "butterfly garden," one can learn surprising things about these insects. They can be extremely aggressive and will even try to drive off human intruders. The males of certain species form "drinking clubs" in which dozens of them drink together at small pools of water (Damrosch, pp.53-66). These are just some of the many interesting facts about their lifestyle. Just observing a butterfly emerging from its chrysalis, drying its wings in the sun, and flying away makes for a remarkable experience. Observing these insects in all phases of their life cycle expands our understanding of how they fit into their total environment -- in this case, a "butterfly garden" -- and might forever change the observer's attitude toward such insects. Knowing more about the life cycles of different creatures and becoming conscious of how we fit into these cycles will change our attitude toward nature, and this changing attitude will eventually change our urban environment.

Designing parks as "living natural-history museums" is one way of designing with nature; the other is to include water purification and other recycling processing plants within the structure of our parks. Artist Viet Ngo provides us with a good example of a water purification plant that was transformed into public art in Gorg, Italy. He developed an innovative system for using the tiny aquatic plant duckweed to filter pollutants from water and convert them into food for wildlife. His artwork is aesthetically pleasing and at the same time an efficient way to treat the problem of pollution.

Design with nature in contrast to *design in nature* is therefore based on an ecological knowledge of the dynamics, interconnections, and composite parts of separate ecosystems. This knowledge leads to an understanding of different life cycles, and forms the foundation for manipulating separate parameters in order to make an environment that will live on its own, yet will be a created "performance of life." This, however, requires a complete redefinition of what the design of an environment is all about.

TIME - CELESTIAL MOVEMENT

All things are connected.
We may be brothers after all.
We shall see.
    Chief Seattle

Time is a concept so deeply embeded in our everyday life that we are rarely conscious of its intimate connection with the movement of the Earth, moon, sun, and stars, as observed and experienced on Earth. Past civilizations, essentially oriented toward the seasons and seasonal changes, were much more conscious of celestial events. Whole cultures, such as the Egyptian and Mayan, were based on predicting celestial events with the hope of controlling the passage of time; this orientation is reflected in their architectural structures which measured cardinal points of a year. Today we do not need time structures to measure time; however, such structures integrated within architectural design may enrich our environment, providing some basic ways of experiencing time and giving an environment a special identity.

We are much more connected with prehistoric cultures than we might think. In our everyday life we can still trace the influence of the Babylonians in the sixty-minute hour and the 360-degree circle. Our calendar dates from 46 B.C., when Julius Caesar, with the supervision of the Egyptian astronomer Sosigenes of Alexandria, reformed it. The result is a calendar that closely follows the ancient Egyptian Civil Year, which was one of the two the Egyptians followed: the Civil Year, composed of 12 equal months of 30 days and with 5 extra days at the end of the year to make a better estimate of the natural year, for practical, administrative reasons; and the Sun Year, used for religious purposes, with a complicated combination of solar, lunar, and other celestial events. So the Gregorian calendar is basically the Egyptian Civil Year corrected to follow the Sun Year. We rarely ask ourselves what the origins of many rituals or celebrations are, such as Halloween in the U.S. or the Carnival in central Europe and other parts of the world. Most of these are vestiges of pre-Christian religious beliefs connected with solar or lunar

calendars. Even May 1st, which used to be such an important Communist event, has its roots in the division of the solar year into eight equal parts marked by both solstices, both equinoxes, and four mid-days, or days occurring between solstices and equinoxes. Thus often we do not realize that the dates on which we celebrate have their origins in the "Heavens."

The human life cycle used to be intimately connected with light. People got up and went to sleep by the sun, and they measured time by the shadows of their own bodies cast on the earth in the sun's light. Since time, at least conceptually, flows on continuously and uniformly, people have constructed numerous time-structures in order to know when to plough, sow, and harvest, when to propitiate the gods so that rains or floods or a good crop would be ensured or evils of one kind or another would be warded off. Several rather obvious naturally recurring events of an astronomical sort were available for time-reckoning. Among these were the day, the lunar month marked out by the phases of the Moon, the solar year defining the seasons, and the progression of shadows following the passage of the sun across the sky, and the rising stars at night marking "hours." Events in the heavens that affected agriculture were predictable, whereas those on earth were not; therefore, it is not surprising that ancient architecture in its design reflects celestial events important to ancient cultures.

Since the life of ancient peoples was so dependent on the events in the heavens, the architecture used astronomical planning not only to keep track of time, but also to communicate religious ideas. Amon-Ra, with his solar manifestation, was the most important god of Egypt. The ancient Egyptians believed that on the day of the winter solstice, when the sun reaches its turning-point, he goes through his annual reincarnation. In 1973, Gerald Hawkins calculated the axial alignment of the Temple of Amon-Ra and found it to be 116.90 degrees east of north, which "was the position of the sun on its southern extreme at winter solstice during the epoch of Hatshepsut and Thutmose, between the years 2000 and 1000 B.C." (Hawkins, pp.207-213). Further investigations showed that another room, called the "High Room of the Sun," dedicated to Ra-Hor-Akhty, the god of the rising sun, was also aligned with the winter solstice sunrise, a finding which proved that even though the main entrance into the temple is from the western side, and the festival hall blocks the way to the temple, the temple was oriented toward the east to admit light of a new-born "sun" on mid-winter day.

Another example of special calendar days integrated within the architectural structure is the Egyptian temple Abu Simbel, which was built by Ramses II as a celebratory monument for his thirtieth jubilee year as pharaoh. It was aligned with the October 18th sunrise in 1260 B.C., the first calendar day of Ramses' jubilee year. According to Hawkins, the ancient Egyptians believed that the rising sun's rays, penetrating the interior 60-meter passage and illuminating the pharaoh statue, brought life and rebirth to Ramses II and started the process of his deification.

Reflections of the Egyptian way of marking time can still be found in some Christian churches. The first Christian church, St. Peter's Basilica in Rome, built on the foundations of earlier sacred sites, is aligned with its apse towards the west. On the vernal equinox, if the doors are open, the sun's rays pass through the church and illuminate the High Altar (Lockyer, pp.98-99). An interesting development of the same idea can be traced in some small village churches on the coast of Croatia.[39] There the small irregular openings in the facade of a church provide an interesting variation of the Christian calendar, which marks time by days dedicated to certain saints. In these churches, the sun's rays penetrating the interior illuminate the paintings of certain saints on their name-days.

The Mayans, who believed in the impact of celestial movement on the success of their plans, were obsessed with the notion of the flow of time. This led them to the development of a calendar that enabled them to predict eclipses. They used astro-alignment for the foundation lines of their pyramids, temples, and plazas. Sunrises were marked by carved stone pillars, such as those at Monte Alto, or later by temples, such as those at Uaxactun, both in Guatemala, which are the best examples of that kind of Mayan approach. A raised platform with three small, roofed temples was built east of the main pyramid. The priest stood on the steps of the pyramid and observed sunrise. On equinoxes, the sunrise occurred directly over the middle temple, and on the solstices, on the outer side of one of the side temples.

> The summer/equinox/winter, triple-temple system was used at more than a dozen of these sites, at different epochs in the Mayan history. (Hawkins, p.183)

Besides employing horizon-based astronomy, the Mayan cultures of Mesoamerica also observed the zenith passage of the sun, which occurs twice a year. On those days, the sun traverses directly overhead, casting no shadow at midday, and forecasts the seasonal shift in the tropics from wet to dry or from dry to wet. These shifts marked the beginning of the planting and harvesting season. At Monte Alban this time was noted on two days of the year, May 8 and August 5 when the light of the sun was filtered through a vertical zenith tube onto a small altar.

The ancient cultures had a penchant for using architecture and landscape to follow the progress of celestial movement.

> [Temples and structures, such as Stonehenge, the Mayan pyramids, or] Egyptian temples, were [truly] scientific instrument[s] of very high precision, as by [them] the length of the year could be determined with the greatest possible accuracy, provided only that the observations were continued through a sufficient period of time. (Lockyer, p.155)

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[39] Unfortunately, a great number of those have been destroyed during the ongoing war.

In modern times, the Jai Singh observatory in Jaipur, India, built in the 18th century by the astronomer Jai Singh, alone measures time in such a precise fashion. Singh set out to design and build naked-eye instruments whose measurements of the sun and the stars would be more accurate than the existing instruments of his era. He built large-scale structures that mark time from moment to moment by the sum, rather than marking only the cardinal points of the year.

In the late 1960s and 70s, some avant-garde artists became interested in prehistoric megalithic structures and in using astro-alignment to celebrate nature or to question the position of humans in the universe. Robert Morris built *Observatory* (1971) in the Netherlands, which consists of two large concentric rings of earth with openings aligned to both solstitial and equinoctial sunrises, similar to the Mayan triple-temple system. Morris' intention with the whole structure was to waken in a viewer an awareness of the different measures of time: the time of the viewer experiencing the piece, the time of human history with megalithic references, and the time of the universe with astronomical alignments. Similarly, Nancy Holt employed solar orientation in her *Sun Tunnels* (1973-76) in Utah. Through pairs of her tunnels one can observe sunrises or sunsets about ten days before and ten days after both solstices.

Charles Ross' *Star Axis*, located in New Mexico, is a unique (though as yet unfinished) sculpture. This monumental structure gives a direct visual experience of precession. The work consists of a 200-foot long concrete cylinder oriented to astronomical north, the infinite extension of the earth's axis into space. Because of a wobble in the earth's rotation, the point we perceive as north changes, over a cycle of 26,000 years. In the time of the great pyramids, around 2,500 B.C., the north pole was oriented to the star Thuban. Now it is closest to Polaris, and in the middle of the next century, this alignment will be almost perfect. The intent of *Star Axis* is to give us an awareness of the motion of the universe in relation to ourselves. By walking through this work, one will be able to experience directly the entire 26,000-year cycle: beginning at the bottom, one will look at a one-degree circle of sky, where Polaris will be seen to rotate around the rim of the tunnel; climbing up the cylinder, at each level one will see a larger circle of sky, each describing the circumpolar orbit of Polaris as the earth's axis moves away from it. An important part of the whole work is a shadow field, describing the earth's seasonally varying relationship with the sun, which Ross previously explored in his *Sunlight Convergence/Solar Burns: The Year Shape* (1972). The piece charts the movement of Earth and sun, forming a spiral shape that reverses in the middle of the year as the result of two natural phenomena: the seasonal drift of the sun through the stars and the annual change in the speed of the earth's orbit.

Besides structures for measuring yearly cycles, history offers numerous examples of sundials, which, in all different forms, measured our time up until the invention of the first mechanical clocks: some of them more simple, measuring just day time, some of them more complicated, measuring also seasonal changes. One might ask what the purpose is of building large sculptural or even architectural structures to measure time today, in the age of computers. There are at least three good reasons to do so: first, to provide a different experience of time; second, to educate; and third, to give an identity to a particular place.

Today, time is measured by digital clocks. But what does 8:00 a.m. or 9:30 p.m. mean? Radio and TV greet us with "Good morning" and provide us with an early weather report. Digital information suggests to us how we should dress and lets us know when to go to work. Since we travel all over the globe, we cannot measure time by the size of our shadow, even if we had the most precise eye. However, "time structures" built into architectural spaces today could provide us with the possibility of experiencing time in some basic ways, which we may otherwise continue to pay little attention to. Fixed positions of astronomical axes enable us to observe the position of the sun and to notice celestial events when they occur. A sundial provides us with a visual and spatial experience of the change in the size of a shadow in relation to "real time," as well as providing an opportunity to experience the difference between our "real time" and astronomic time.

Such an experience of time conveys knowledge -- knowledge beyond the basic relationships between the sun, the moon, and the Earth. It also conveys knowledge of past civilizations. Being lucky with the weather and experiencing the beauty of the sunrise or the sunset when the sun's rays penetrate a time-temple's or similar time-structure's entire length may help us to understand the power of those who knew how to predict the exact time of such events over those who did not have such knowledge. Being able to predict time in ancient civilizations meant being in touch with the gods and sharing in the gods' power. In Joseph Campbell's opinion, by building time-temples, early peoples did not just share in the power of the gods, but by controlling the ritual, exercised power over them.

There is another reason for incorporating time information within architectural structures and emphasizing it artistically, and that reason has to do with identity. It often happens that there is no practical reason for a structure's specific orientation or that the most logical orientation very closely coincides with one of the astronomical axes. In this case, why not align the structure perfectly with the axis, thereby integrating a "celestial event" within a design to give a part of the architectural structure a special identity? By artistically incorporating such an "event," the structure would carry and communicate astronomic information and perhaps make some of us observe the simple world around us with eyes a little more open.

APPENDIX -
INTERACTIVE WATER CURTAIN

"When you look at it, it's not sufficient to be seen;
When you listen to it, it's not sufficient to be heard;
Yet when you use it, it can't be used up."
                                        Lao Tzu[40]

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[40] Translation by R. G. Henricks.

THE GENESIS OF INTERACTIVE WATER CURTAIN

One of the most important influences that serves as a constant inspiration for my work is definitely my desire for constant contact with nature and an irrepressible urge to play. As a landscape architect I have always been attracted to water as a medium for creating pleasant environments. However, at CAVS I have become familiar with many new concepts for integrating unrelated media and technologies in order to create a unique experience. The most inspiring work for my *Interactive Water Curtain* was a temporary installation *Steamshuffle*.[41] by Joan Bringham and Christopher Janney, artists whom I met at CAVS. Not only did their work directly influence my fountain, the conversations with them spurred my imagination. Part of that, I hope, can be seen in this project.

INTERACTIVE WATER CURTAIN

The *Interactive Water Curtain* is a proposal to integrate water within an architectural structure to serve not only as a functional divider of a space and provider of pleasant background sound that masks unpleasant environmental sounds, but also to transform an environment into a synesthetic experience, providing a variety of encounters that appeal to all the senses through various means of interactive play.

Description of the Project

The proposed project is a long water curtain (at least 30 feet long), placed in a space so as to allow an observer to experience it from both sides. Placed in the interior of a building, only the water itself is visible; the rest of the fountain's structure is hidden. One can, therefore, see the water curtain only when it operates. If placed outdoors, the upper part of the fountain structure is a long exposed beam, while the bottom part is integrated into the pavement. The fountain is minimal in the design of its structural parts; however, the water itself, through the control of its movement, becomes very expressive artistically. It forms visual and aurual patterns. Visual patterns, which one can observe from a distance, appear on the surface of the water curtain, while one can hear the sound effects while walking along the fountain.

Visually, the water curtain consists of successive lamellas,[42] each of them a

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[41] More detailed description of the artwork is to be found in the Introduction as well as in the section on Water.

[42] A lamella is a thin plate or screen. In this context it refers to a thin water sheet coming from a specially designed valve.

separate system that can appear in various ways: it can be a thick curtain of water when people, walking along the fountain, activate the valves that allow sheets of water to fall from the top of each lamella; it can be a veil of water drops when there is no interaction of people with the fountain; or it can disappear because the flow of water is closed. Therefore, the visual appearance of the curtain is changing over time, and the visual patterns that are formed appear as the ever-changing lace on the surface of a curtain.

The major structural parts of the water curtain are two water tanks: one at the top and one at the bottom. The top one contains water under constant pressure. On the bottom of the top water tank there are specially designed long water valves, which form successive lamellas of the water curtain. At the bottom there is a V-shaped long bowl that catches the falling water.

Each successive lamella of the water curtain is a separate system, connected to a control system that regulates the water flow and to a sensor that allows interaction between the fountain and people passing by.

There are two kinds of proposed sensors: a photoelectric eye and a pressure-sensitive switcher. Each of them is used to activate different performances. The photoelectric eye (sensor A) is positioned further away from the fountain to catch the movement of people passing by and to activate splashes of water. The pressure sensor (B) is positioned closer and requires people's active participation. Depending on the number of people passing by, the sensor closes or opens the water flow for a programmed duration of time.

Both sensors provide signals to a control mechanism that regulates the opening and closing of the water valve for each successive lamella of the water curtain. A-sensors always activate splashes of water (sheets of water). Because they are activated successively by a person's walk (passive interaction), they are manifested on the surface of the water curtain in a continuous pattern (curve). In contrast, B-sensors have a discontinuous, step behavior, since they are a visual manifestation of people's active interaction (stepping on special tiles). The control mechanism's function is to translate signals from the sensors into a proper function of opening or closing the valve with proper (A or B) delays.

The Elements of Interaction

The interaction of people with the fountain forms visual and sound effects. People, simply by walking, cut the light beam of a photoelectric eye, which is a sensor that activates a control mechanism that for a short time turns on a section of the water curtain and allows large flows of water to fall. Therefore, just a few people walking along the water curtain and triggering switches (cutting the light beams of photoelectric eyes) represent an ongoing

performance of interplay between people and water, which one can observe from a distance. If no one is interacting with it, the curtain consists only of dripping water, which transforms the environment into a contemplative space.

A person walking by and triggering the switches hears "water waves hitting a shore," but sees nothing, since the effect is coming from behind. This is the element of ambiguity and puzzlement integrated within the fountain, which invites the passerby to slow down and to try to make sense of her/his experience -- which may eventually stimulate an observer's curiosity.

By trying to figure out what causes the sound, one might discover photoelectric eyes and start playing with them, causing a change in the movement of the water. This kind of interaction with the fountain transforms it into a playful game, since, when the triggers are discovered, the passive participants may be transformed into active players engaging in a playful game.

In order to experience the fountain's most important visual effect (the ongoing performance of people-water interaction), which is manifested visually as a parabolic curve on the surface of the water curtain, one must move away from the fountain and observe it from a distance. Through attentive observation, one might also notice the rainbow effect on the ceiling of an interior where the fountain is placed, or if placed outdoors, at night, on the surface of water particles of fog or steam. An attentive observation of the fountain's visual and sound effects is another very important possibility for interaction with the fountain.

When there are many people passing by, the fountain is very active and, with the increased activity, its visual and sound effects blend into a constant flow of water. When the level of activity reaches that degree, there is another possibility for interaction. People, by stepping on special tiles positioned close to the fountain, activate mechanisms which shut down certain sections of the water curtain for a minute or two. Such an addition to the original idea transforms the water curtain into a "playground," and invites people to go through the curtain, which may be an interesting variation for the water garden outdoors.

Sound Effects

As a person walks along the fountain, she/he triggers splashes o f water from successive lamellas. This in turn creates the splashing sound that follows a person. The difference in the speed of a person's walk produces different rhythms of a "splashing music." So, when there are many people interacting with the fountain at the same time, we get a "poly-rhythmic splashing music."

With the control mechanism and design of the valve it is possible to create different "splash" sounds. Each wave sound can be seen in musical terms of attack, sustain, and decay. Attack, in this case, is the manner of opening a valve, sustain is the duration of a sound, and decay the manner of closing a valve. Therefore, the sound of a splash can be changed over time.

When the level of activity (the number of people passing by) increases, the water curtain performs a different function. Since it is responsive to the level of activity in its surroundings, the visual and sound effects blend into a constant flow of water with the increasing number of people activating the fountain. The sound increases to the level of a waterfall. This provides a constant white noise, which masks the unpleasant sound of various human activities. In this sense, the water curtain performs an ecological function by cleansing the auditory environment of unpleasant sounds in order to appear psychologically quieter.

When there are no people around, the water fountain is quiet and the valves are almost closed. They are only open enough to allow a few drops of water to pass through to constitute the water-curtain and are heard as contemplative environmental sounds.

Visual Effects

Water is the only exposed part of the water curtain and its movement can be highly sophisticated and controlled by computer. To make changes in the flow of water visible, a solenoid valve that controls the quantity of water should be specially designed to fit the needs of the desired visual effect.[43]

The most important visual effects of the Interactive Water Curtain are different wave curves corresponding to the patterns of people's movement, which register on the surface of the water curtain. One must move away from the fountain and experience it from a distance to discover the ongoing performance of people-water interaction. When triggered by a person walking by, the water wave follows her/his movement, transforming the water movement which is graphically recorded on the surface of the water curtain as an ever-changing record of people's movement in space and time. The visual image is a parabolic curve, whose steepness tells us about the person's speed of movement: a steep and short curve means slow movement, and a gradual and long curve signifies fast movement.

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[43] PEM Fountain Corporation from Orlando, Florida designs and produces solenoid valves to meet the requirements for special effects in fountain design.

To make the slight changes in the flow of water visible, the water curtain is illuminated by a sheet of light from below, which gives the water a volumetric quality. In a dark space it becomes a light fixture, responsive to human activity and illuminating the space around it. More people means more water, and more water means more light.

Another light effect is provided by the prismatic shape of the water bowl under the water curtain. With an ingenious shape of the bowl, and with good illumination, one can get variations of a rainbow effect reflected on the walls and ceiling of an interior where the fountain is placed, or if placed outdoors, at night, on the surface of water particles of fog or steam.

Placement of the Fountain

The placement of the water-curtain in the proper environment is a very important task. For the best visual effect, the environment has to have the dynamic rhythm of human activity with a large number of periods of peak usage. Therefore, a space should be an important path, which people use at various times. Another important criteria is the mixed use of space. The water-curtain must be incorporated near a place where people take time to sit. Such a place can serve as a good observation point for the fountain. Besides this, the fountain can be placed in the environment as a functional element that will divide a space in order to direct the traffic flow, or just to provide two functionally separate, but visually connected environments.

An example of such an environment is an airport terminal, which has a lot of peaks of passenger traffic as well as longer nearly quiet periods. People wait for a flight, and therefore, have time to observe. At the same time, the frequency of passengers' activity is constantly fluctuating between very busy and quiet, which means extensive changes in the fountain's behavior.
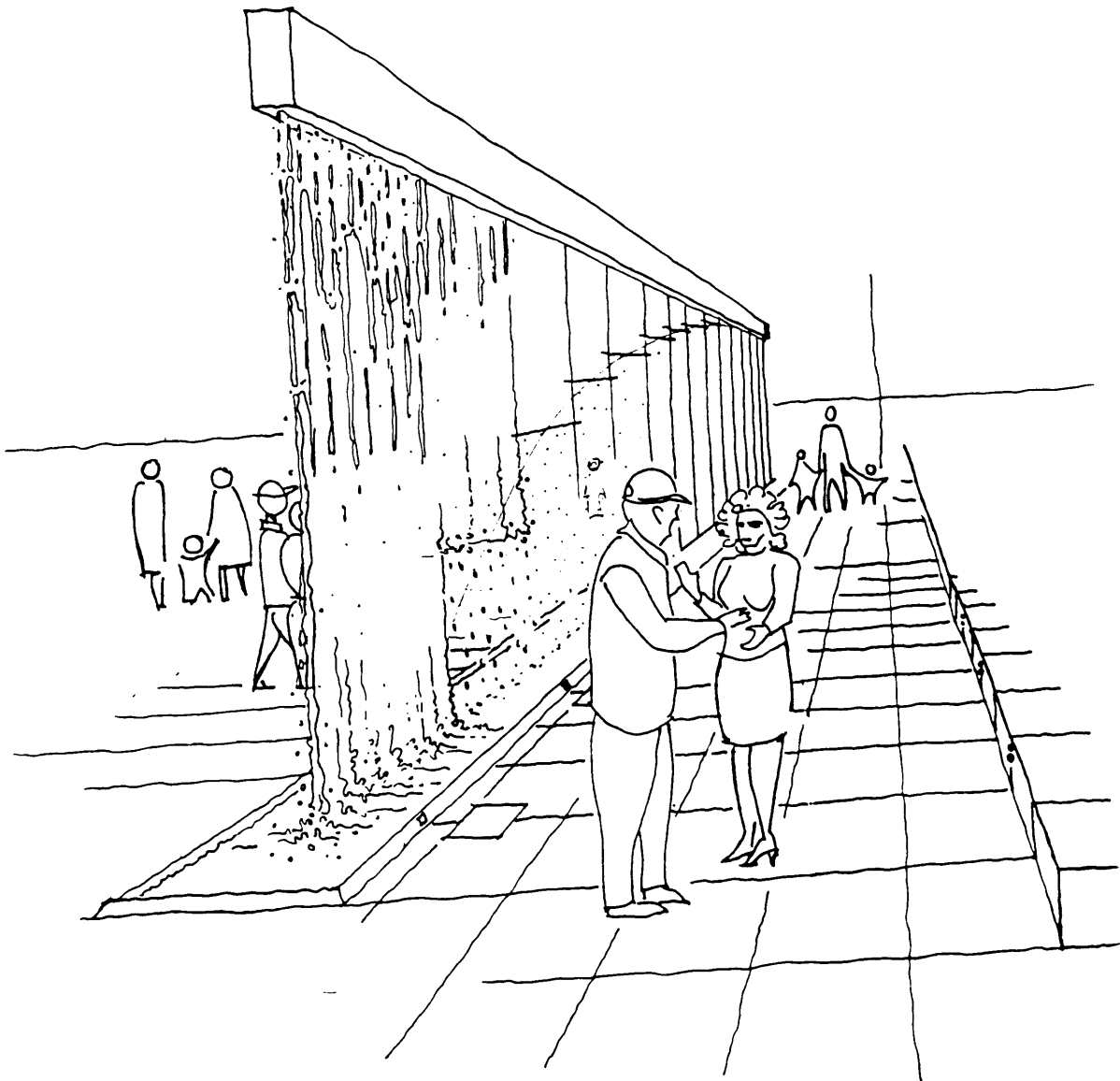
Fig. 1
Interactive Water Curtain - view.
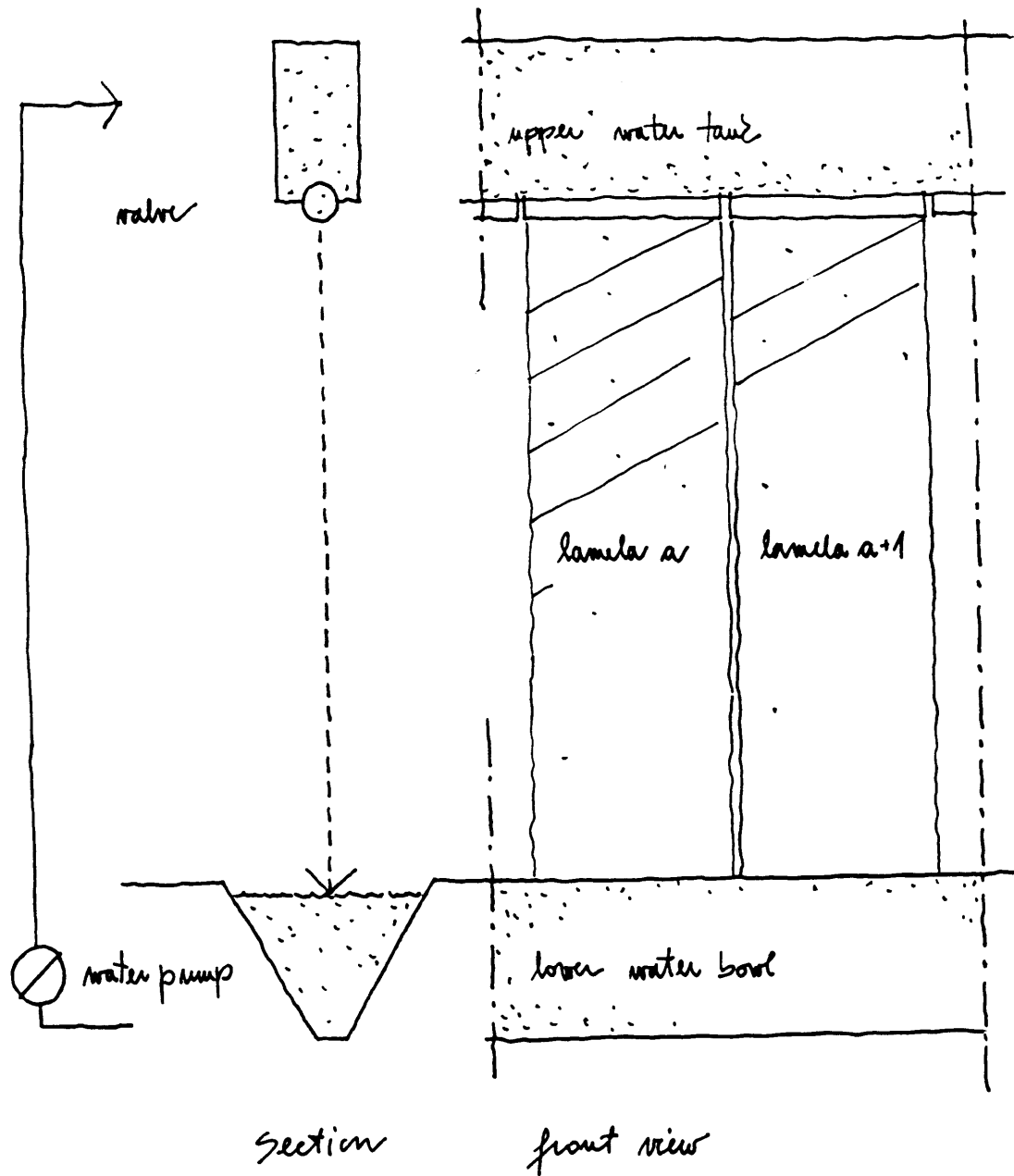
Fig. 2
Basic structural parts of the *Interactive Water Curtain*: water tank at the top with successive specially designed long water valves, water bowl at the bottom, and water curtain between the water-carrying structures composed of successive lamellas, each controlled separately.
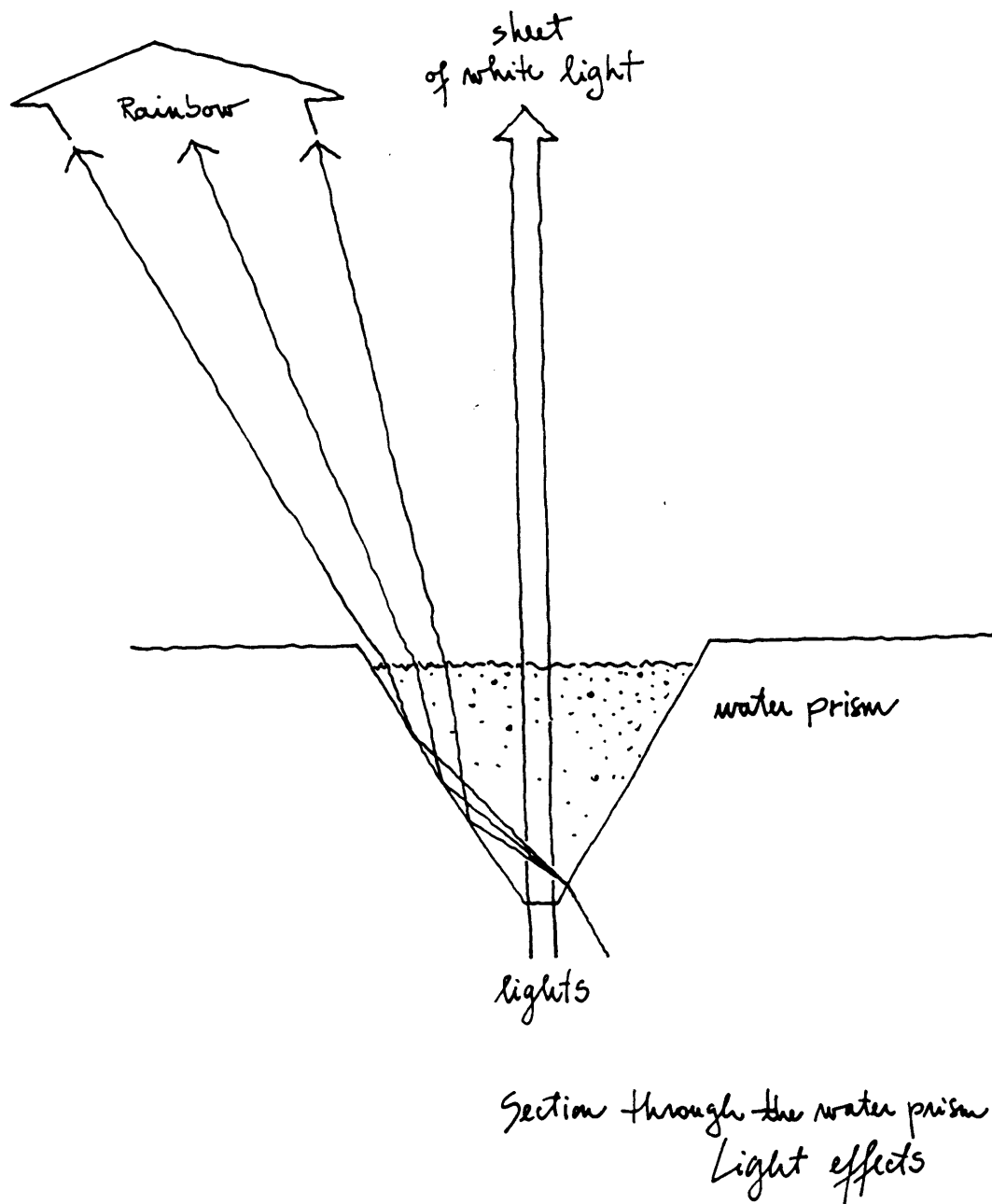
Fig. 3

Lighting of the fountain from below makes water appear volumetric. Manipulation of the surface of the water bowl and the angle of light coming into the water prism produces a sheet of light and rainbow effect.
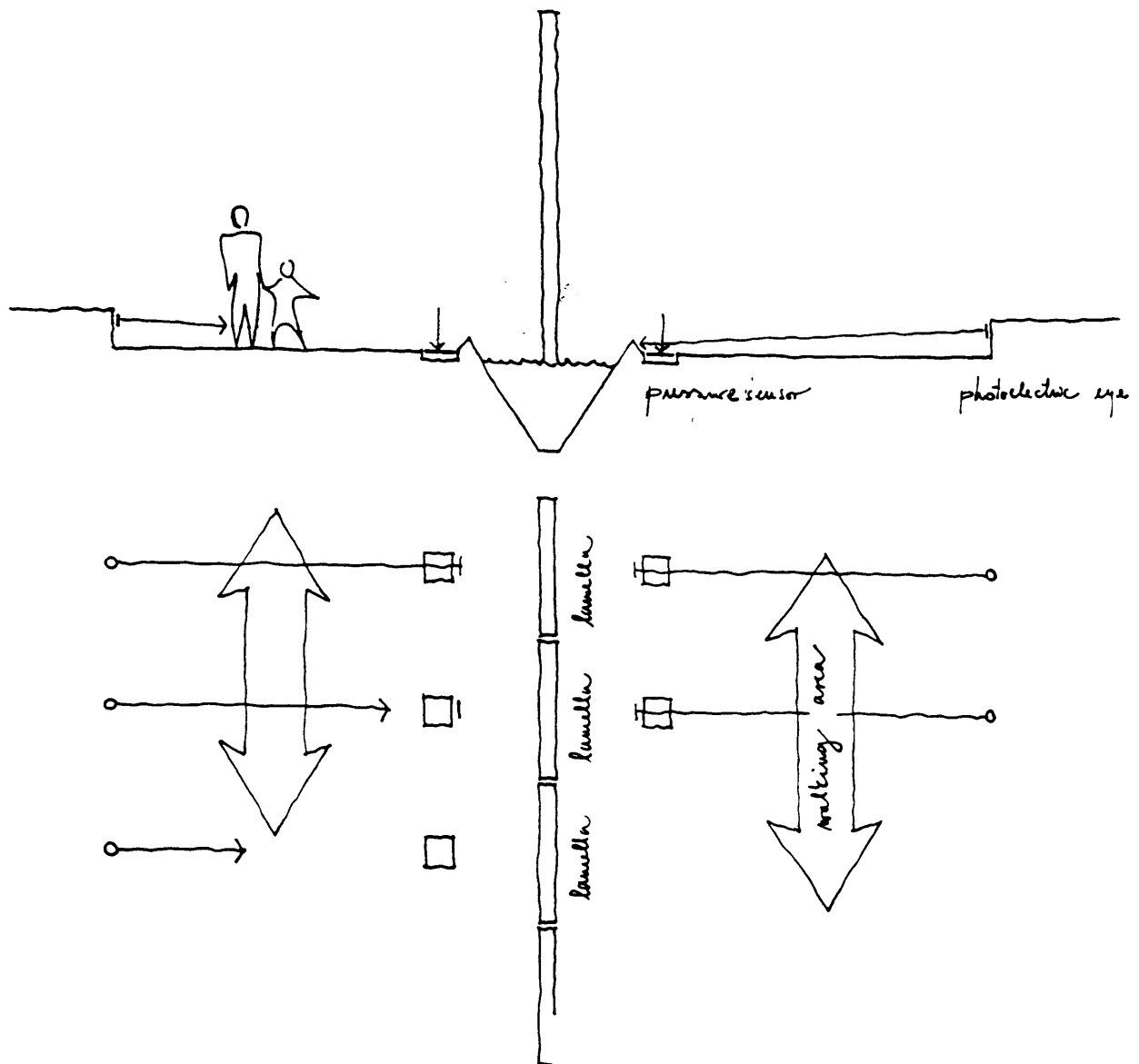
Fig. 4

The fountain is positioned in space sop as to allow movement on both sides. Sensors A (photoelectric eye) are positioned further away to interact with people who are passing by and sensors B (pressure sensors) are meant for active interaction (play) with the fountain.

- 82 -
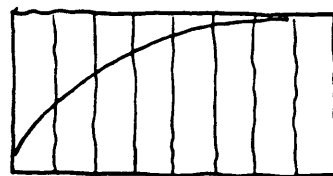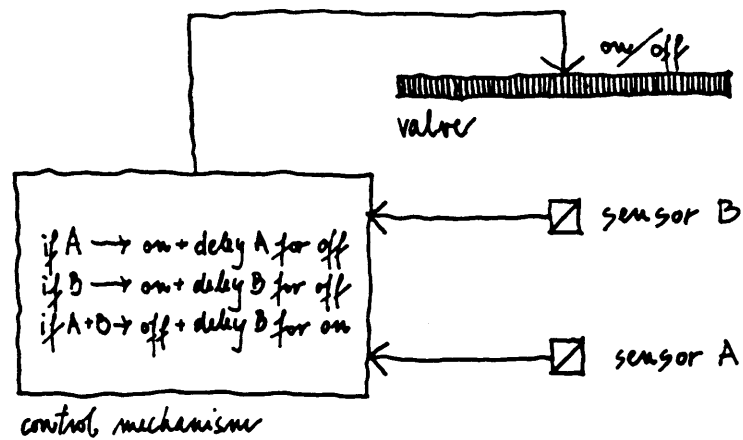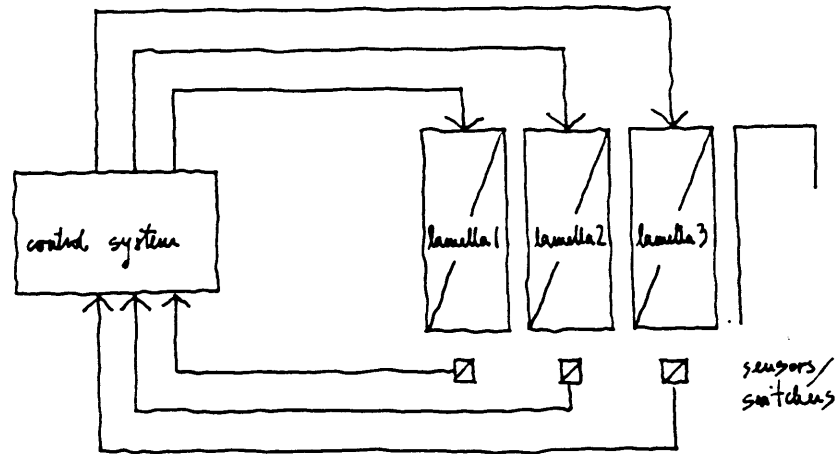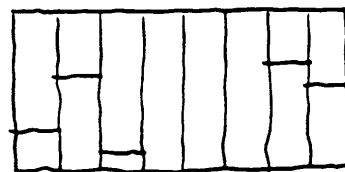
Fig. 5

Each successive lamella is a separate system controlled by a control mechanism. Sensors A correspond to a continuous parabolic visual image of the curtain, while sensors B correspond to a discontinuous step image.
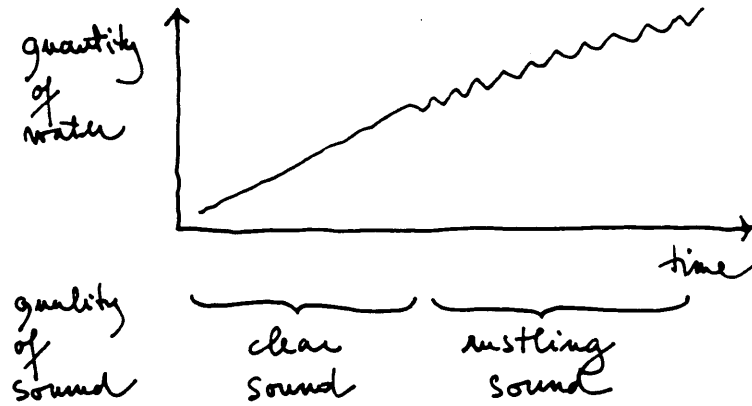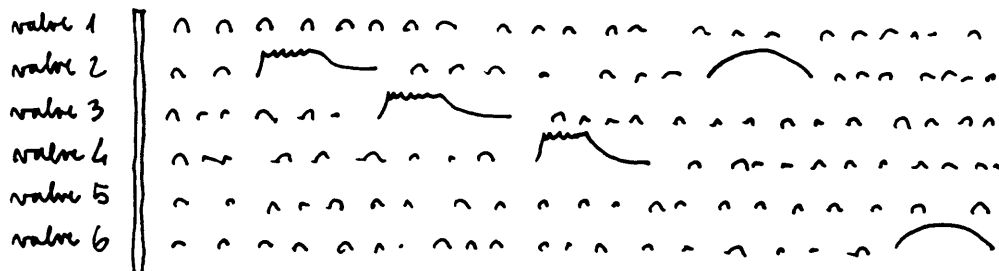
Fig. 6

The quality of water sound changes depending on the quantity of water coming through the valve. Each water sound can be seen in musical terms of attack, sustain, and decay. Attack, in this case, is the manner of opening a valve, sustain is the duration of a sound, and decay the manner of closing a valve. With those sounds one can write a score.
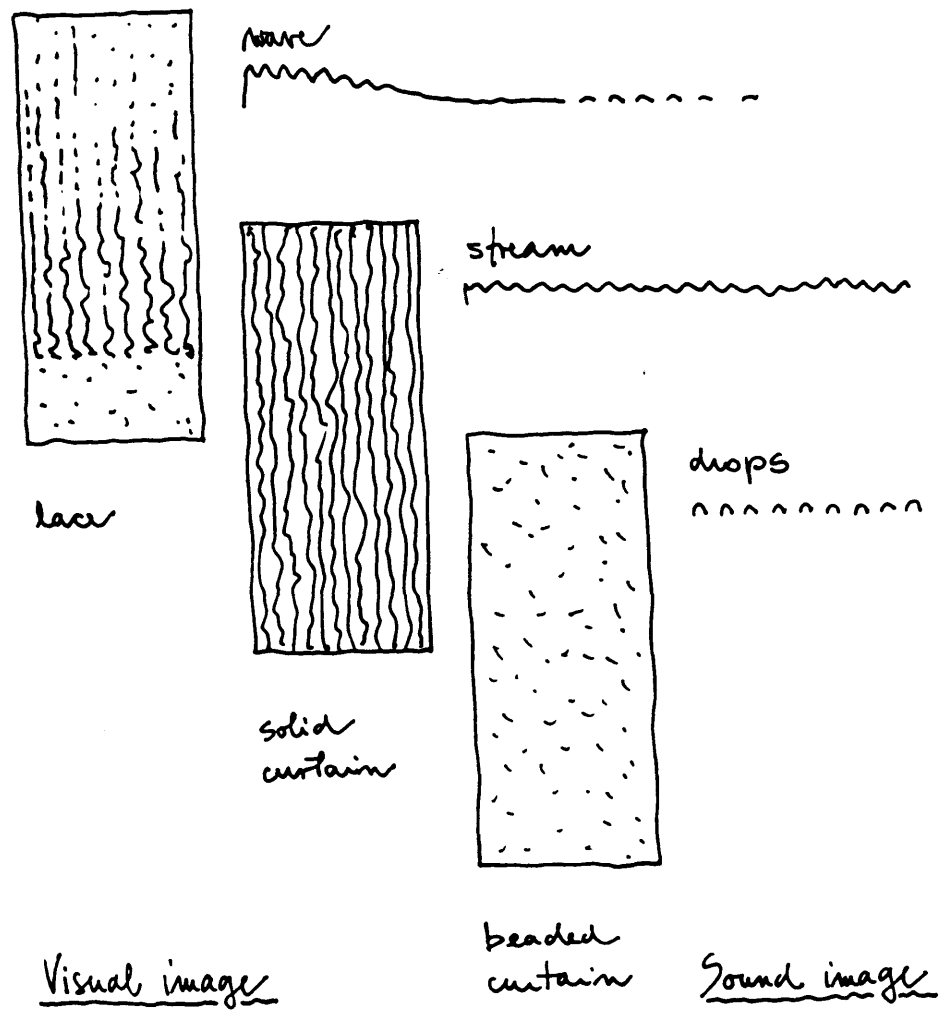
Fig. 7
The quantity of water coming through a specially designed long valve produces various visual and corresponding sound images.
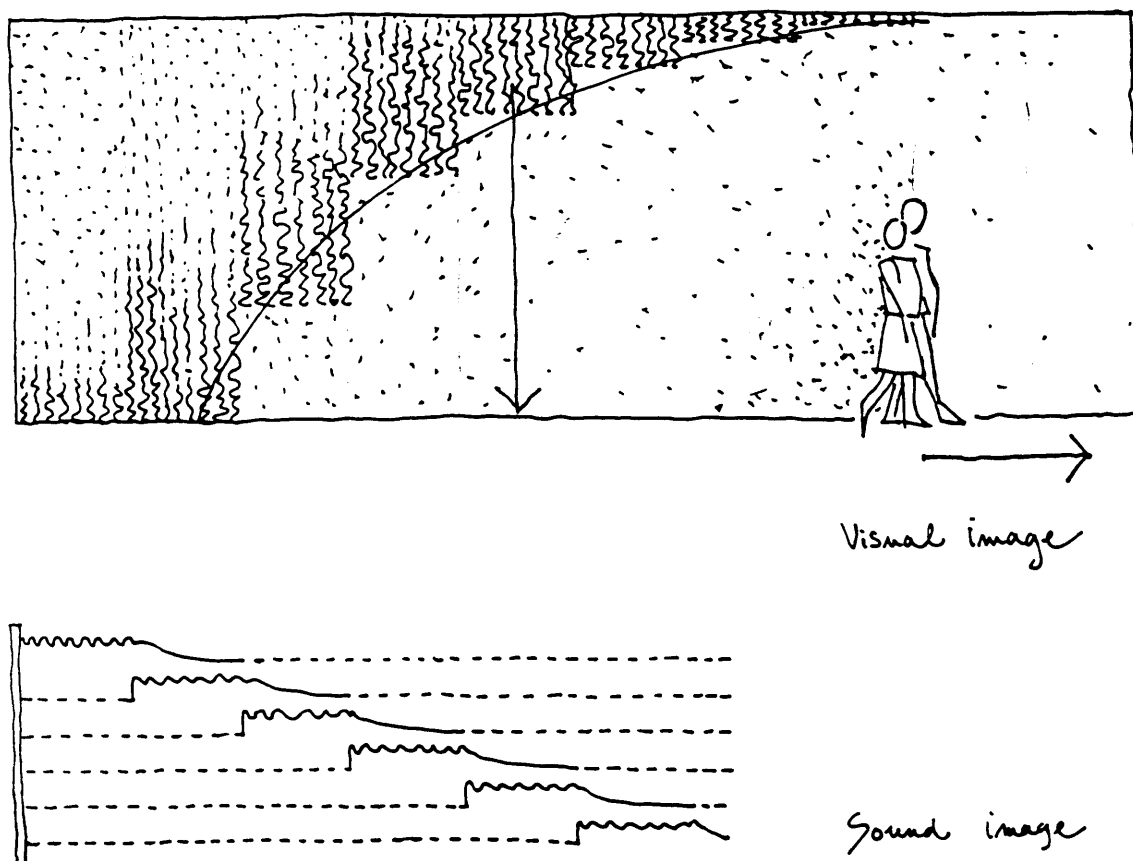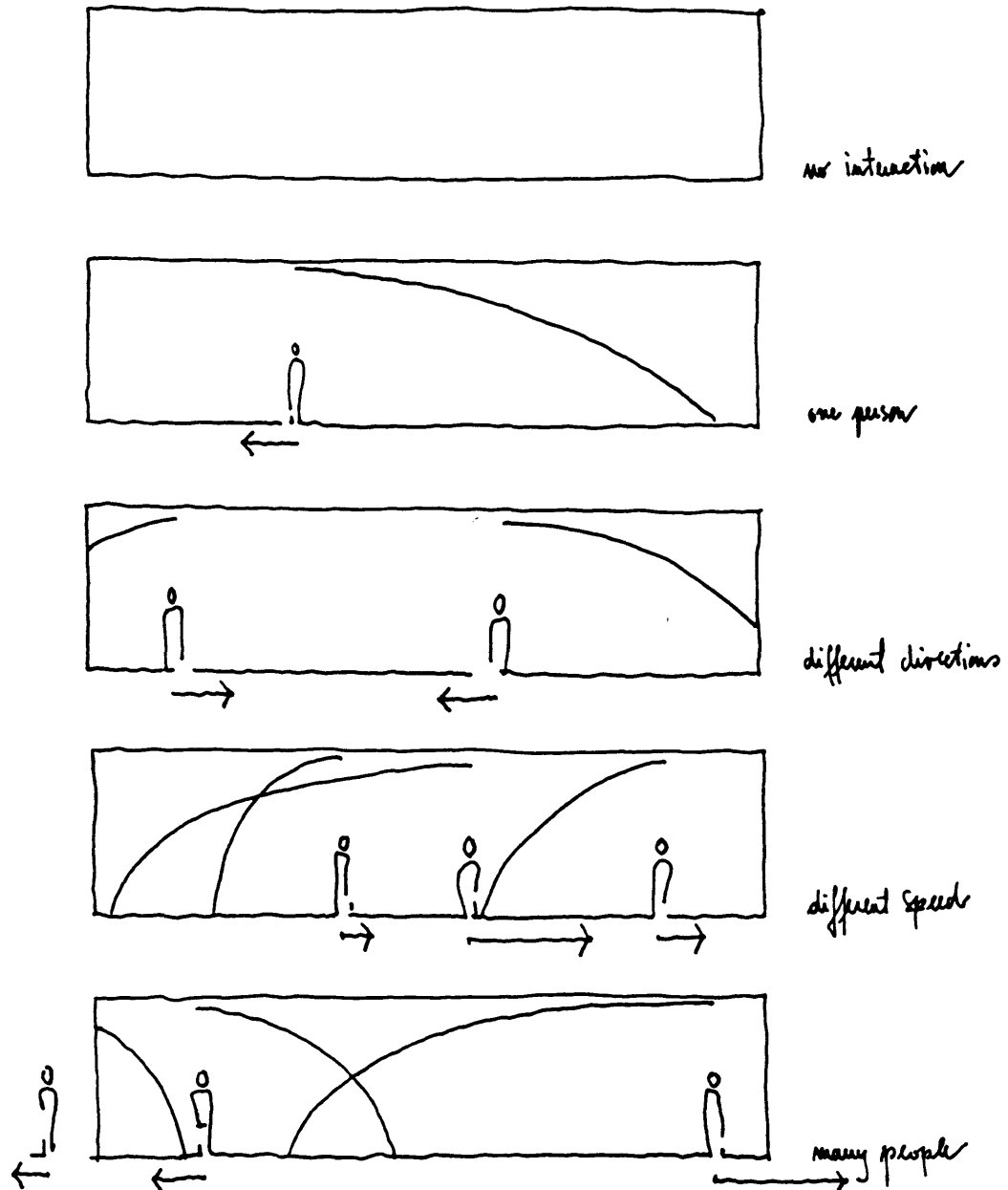
Visual image

Sound image

Fig. 8

Corresponding visual and sound image produced by passive interaction (passing by) of people with the fountain.

Visual effect - passive interaction

Fig. 9

Visual effect produced by passive interaction of the people passing by the fountain. The change in visual appearance of the water curtain depends on a number of people passing by, the direction of their's movement, and their speed.
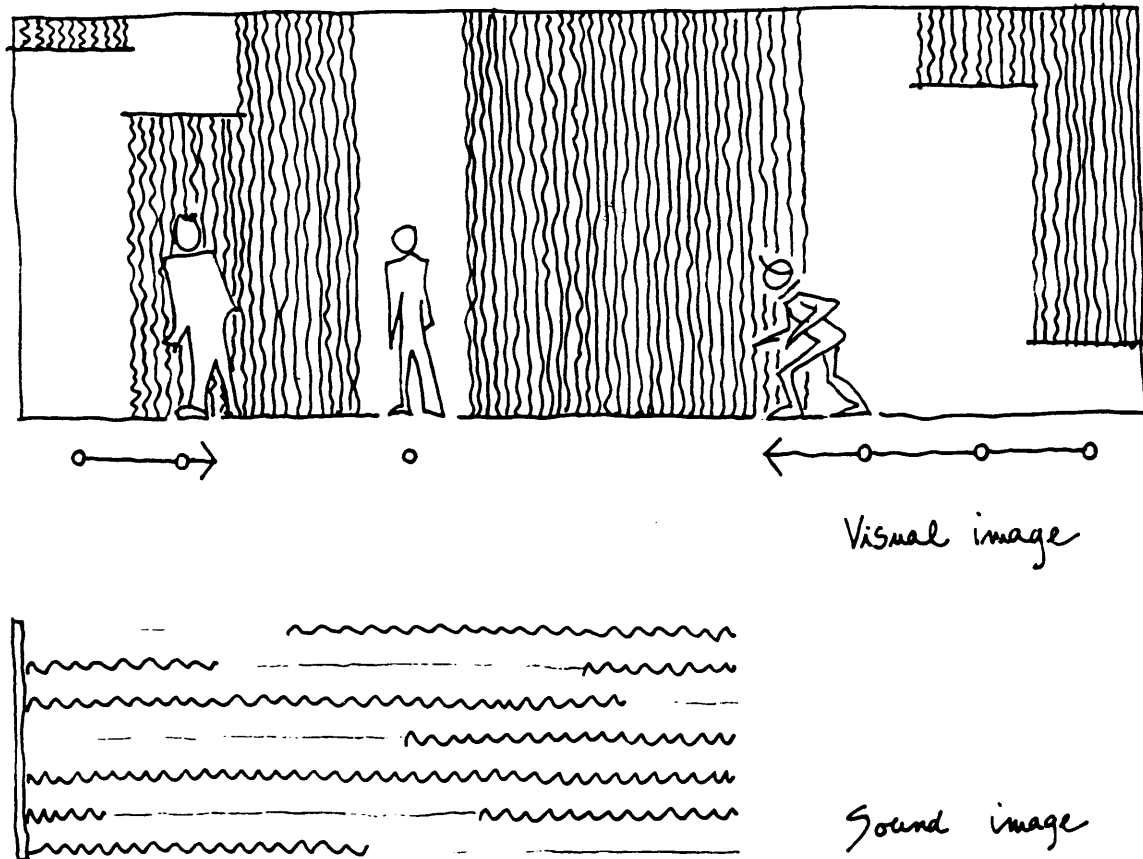
Fig. 10

Corresponding visual and sound image produced by active interaction (play) of people with the fountain.

no interaction

moving person

many people

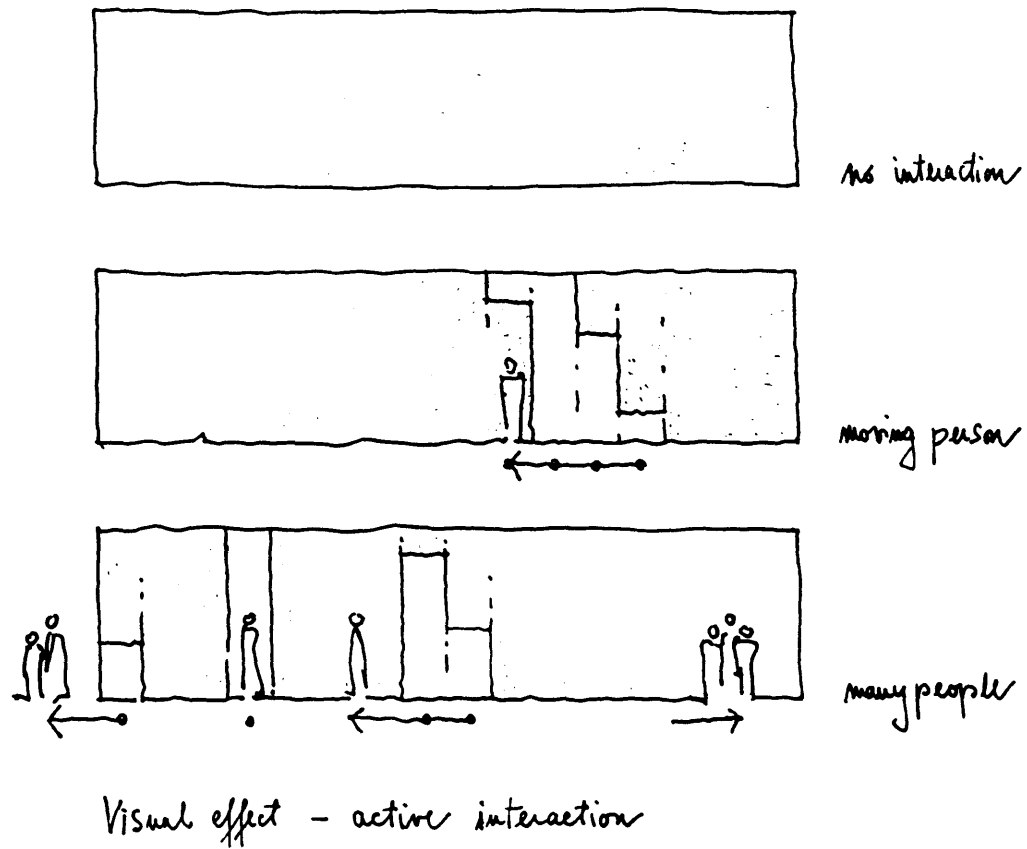*Visual effect - active interaction*

Fig. 11

Visual effect produced by active interaction of the people with the fountain. The change in visual appearance of the water curtain depends on a number of people actively stepping on special tiles (pressure sensors).

THE PROTOTYPE

A prototype has been developed to test the visual and sound effects created by the control of water movement. Since the prototype consists only of one short lamella, the whole effect cannot be shown. However, the prototype was a good test of some still unexplored artistic possibilities in the fountain design provided by the creative use of technology. One of the goals of the prototype was also to design it in such a way that it could itself be an interesting fountain; consequently, I slightly modified the lamella of the prototype.

Description of the Project

The prototype consists of one lamella, which is divided into a V-shaped bowl section at the bottom (on the floor) and a reservoir section above (below the ceiling). The sculptural part of the piece is the falling water itself, illuminated with a sheet of light from the bottom. Lit in this way, water becomes a carrier of light, and therefore, takes on a volumetric appearance, which allows minimal changes of the falling water to become visible.

Both structural parts of the fountain are to be integrated within the structure of the ceiling and floor of an architectural space. In the case of the final presentation of the prototype, this was done in the hallway of the CAVS building.

The major difference between the proposed conceptual project for the water curtain and the prototype is in the design of the water valve. In the prototype, the specially designed highly sensitive solenoid valve is replaced with ten simple solenoid valves that are regulated by a control mechanism in order to allow a gradual change of water flow. In the proposal, a specially designed solenoid valve also takes care of the equal distribution of water along the length of each lamella. In the case of the prototype, I designed a spill that allows a desired distribution of water along the lamella.

The movement of people is translated by the photoelectric eye into the movement of water, which is manifested visually in the changing appearance of the falling water forming the water curtain. People coming closer to the water curtain trigger the beam of light. The light beam serves as a switch that starts the "performance" of falling water -- the visual and aural manifestations accomplished by the series of commands that control the manner and rhythm of opening and closing the valves. When the light beam is cut, the valves open, and they successively close with programmed delays. As time passes, different quantities of water compose the water curtain and change its visual- and sound-manifestation.

Visual Effects

The desired visual effects of the *Interactive Water Curtain* are different wave curves corresponding to the patterns of people's movement, registered on the surface of the water curtain. The visual effect depends for the most part on a length of the water curtain (a large number of successive lamellas), as well as on the observer's distance from the curtain. Since the prototype consists only of one lamella, I modified the lamella in such a way as to provide interesting changes in its visual appearance when standing alone.

I divided the lamella into three parts. The outer two parts are designed in such a way as to allow only water drops to pass through, while the design of the middle part allows a transition of water flow from the sheet of water to separate jets eventually turning into water drops. When there is a large quantity of water, it flows down in a curtain; if there is a medium flow of water, it flows in separate jets; and if there is almost no flow, there are only water drops. The visual effect is a nice gradual transition of the flow of water in the middle part of the water curtain.

There is another visual light effect accomplished in the piece. The V-shaped plexiglass bowl holds a water prism which, illuminated from below, splits light into the spectrum. Projected on the ceiling and walls of the space it creates a nice contemplative effect when the fountain is quiet.

Sound Effects

When the light beam is cut, the valves open and close with programmed delays. Since there are ten valves, there are numerous possibilities for programming the manner in which the valves open and close. Concentrating only on a sound effect produced by one lamella, I experimented with different "splash" sounds. I chose the "splash" sound that starts loudly and slowly become quieter until only water drops remain. Therefore all the valves open at the same time, and then successively close with different delays. As time passes, different quantities of water compose the water curtain and shape its sound.

With the help of Dennis Thurmond, a jazz musician, I produced a four minute-long musical piece using synthesizer and recordings of water sounds in order to demonstrate the possible sound experience of the proposed *Interactive Water Curtain.*

Starting the production of the sound piece, I gathered suitable sample-sounds that could simulate the sound experience of the *Interactive Water Curtain.* Using a simple water valve in my studio at CAVS at MIT, I produced different samples of water sounds simply by hand, using different patterns of

closing and opening the valve, and digitally recording the samples. From the recording I chose two samples: a *Splash* sound for the falling water and a *Drop* sound for the silence as a background between the splashes. Each of the two sounds was digitally modulated and mapped on the whole length of the keyboard of a synthesizer in such a way that the pitch slightly changed, which added more depth and spatial character to the sound.

The musical piece demonstrates the sound experience of the fountain, which is quiet when there is no interaction with people, and loud when people passing by trigger water splashes. During the "silence" it is possible to hear just water drops, therefore, the background consists of random water drops. The splash-sounds are produced by people's movement, therefore, walking the fingers on the keyboard of the synthesizer, I simulated those rhythms. When Dennis added some environmental sound to the "sound of the fountain," we got an example of a possible sonic experience of the *Interactive Water Curtain*.

The final version of the sound piece is stored on 5.25" Removable Hard Disk Cartridge (SQ400) and a digital audio tape (DAT). The musical piece was produced using the following equipment and tools: an Apple Macintosh computer (IICI) with DigiDesign Samplecell, Korg Wavestation A/D, Sound Accelator (DigiDesign) Sound Tools, Kurzweil K2000R with Sampling Option, SoundToolsII (DigiDesign), and Opcode Studio Vision 1.43.

SOME OTHER POSIBILITIES

Water Playground

A water playground uses the idea of people controling water movement by stepping on special tiles and develops it further into an interesting variation that can be used in the water garden outdoors. In such a playground, there may be many water curtains comprising a complex spatial structure through which people have to move by closing the water flow as a result of stepping on special tiles.

Musical Fountain

We get a musical fountain when sound becomes the most important concept in the design of a fountain. One simple highly sensitive valve, together with a well designed amplifying tube that catches the falling water, can produce a variety of sounds. These sounds can form interesting "environmental music." This cannot be "music" in the usual sense; however, it can have some modulation and a variety of rhythms.

If the fountain is regarded as a musical instrument, one can write a score for it. This kind of "music" can be an interesting white sound. In order to write a score for such music, one should record different samples of water sounds using variations of valves and amplifiing tubes. When the variations of sounds are recorded and selected, they can be mapped in their original form on the keyboard of a synthesizer. Then, a "music for a hundred valves" can be produced. A number of sequences that can be combined randomly gives music some variation throughout long periods of time. When each sequence of the music is produced in its final form, the "music" must be translated back into the information for the valves, the amplifying tubes, and the proper timing. This information, inserted into a computer program that controls the water movement for each valve, is then a score which is played by the "hundred valves of a musical fountain."

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