THERMAL DELIGHT IN ARCHITECTURE

by

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Abstract

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This thesis examines the broad range of influences that thermal qualities have on architectural space and peoples' response to it. It begins with the observation that proper thermal conditions are necessary for all life forms, and examines the various strategies used by plants and animals to survive in spite of adverse thermal conditions. Human beings have available to them the widest range of thermal strategies. These include the skillful use of building technologies to create favorable microclimates, and the use of artificial power to maintain a comfortable thermal environment.

Survival strategies and the provision of thermal comfort are only the most basic levels of our relationship to the thermal environment. Our experience of the world is through our senses, including the thermal sense. Many examples demonstrate the relationship of the thermal sense to the other senses. The more sensory input we experience, and the more varied the contrasts, the richer is the experience and its associated feelings of delight. The hearth fire and the Islamic garden are cited as archetypes of thermal delight.

The use of thermal objects and places are related to cultural patterns. They can provide a sense of well-being which engenders an affectionate bond with the place or object. A place with positive thermal qualities is likely to serve as an important social gathering place, such as the hearth, the cool Italian square, or the Japanese bath. Rituals which develop around the use of such places reinforce the bond of affection for it.

Many thermal places acquire remarkable significance within a culture, occasionally even at a level of sacredness. The ancient sacred traditions around the hearth and the sauna are examined, and loosely compared to modern thermal systems. Roman baths and South Indian stone temples are discussed as examples of the conjunction of thermal space with political or religious ideals. The symbolism of the Islamic paradise garden, and the hearth, are shown to be expressive of the life and spirit of the owner.

Perhaps the skillful use of thermal qualities in architectural design can generate such delight, affection, and sacredness.

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Foreword

This work began with the hypothesis that the thermal function of a building could be used as an effective element of design. Thermal qualities--warm, cool, humid, airy, radiant, cozy--are an important part of our experience of a space. They not only influence what we choose to do there, but also how we feel about the space. An analogy might be drawn to the use of light quality as a design element, truly a venerable old architectural tradition. The light quality--direct, indirect, natural, artificial, diffuse, dappled, focused--can be subtly manipulated in the design of a space to achieve the desired effect. Thermal qualities might also be included in the architect's initial design intentions, and influence all phases of design. Instead, thermal conditions are commonly standardized with the use of modern mechanical systems that can be specified, installed, and function independently of the overall design concept. Indeed, environmental control systems tend to be treated rather like the Cinderella of architecture; given only the plainest clothes to wear, they are relegated to a backroom to do the drudgery that maintains the elegant lifestyle of the other sisters (such as light, form, structure, etc.).

I became intrigued with the design potential of thermal qualities

as I was working on the design of a solar building. Rather than simply housing an autonomous mechanical system, the building itself acted as the thermal system. The livingroom was both for living in and for collecting heat. The south windows were both for a view and to let in the warmth of the winter sun. Thermal shutters, closed at night, made the house more introverted, while also saving heat. I began to wonder what the implications of the thermal qualities of this building were for peoples' experience of it. I realized, however, that there were very few references from which to draw. The one obvious analogue was the fireplace. The solar-heating functions of the building were essentially a replacement of the original thermal functions of the fireplace. With its circle of warmth, the fireplace had once been the center of family life. Its dancing light, smoky smells and warm crackling created an ambience that made a house more a home. And the traditions around the hearth stretched back through the ages, connecting each house to deep cultural roots. How might the solar house incorporate some of the richness of the hearth? What were the qualities of the hearth that made it so wonderful, and so beloved?

I decided to look not only at hearths, but at a wide variety of places which had strong thermal qualities, to see what contribution thermal qualities might make to the use and the sense of a place. I gathered examples from a broad spectrum of cultures, and historical periods, with the assumption that there was a universality

of human experience which might be distilled from them. I looked at the examples, not with the eye of the historian (How they came to be?), or of the engineer (How do they work?), but rather with the eye of a designer (How is it perceived? What role does it play in peoples' lives? What is wonderful about it? How is it part of a greater whole?). Unfortunately, information on peoples' use and experience of places tends to be sparce, especially in comparison to descriptions of history or function. It is perhaps a sad commentary on the state of architectural literature that so little attention is paid to how people actually use spaces, and what they feel about them. The most illuminating descriptions are often written by anthropologists, literary travelers, or poets.

Other than the hearth, perhaps the richest example of a thermal place that has a profound role in its culture is the Islamic garden, the cool oasis that is the traditional center of the Islamic house. They might be regarded as two archetypes: the hearth, a refuge of dry warmth from a cold world, and the oasis, a preserve of coolness and moisture amidst a desert wilderness.

It is hoped that this collection of disparate examples may serve as a set of references for the designer. It draws no firm conclusions and sets no guidelines, but rather, offers some background information and a bit of musing that are the first stages of any design work.

The Thermal Necessity

Life exists within a small range of temperatures. It comes to a standstill as water freezes and even the hardiest of bacteria are destroyed when water boils. Each species of plant or animal has definite thermal limits within which it can survive, and an even narrower range of temperatures where it can successfully compete with other species. Ecologists have discovered that as little as a $2^{o}F$ change in the average temperature of a lake will shift the dominant fish population from bass to catfish, as one species becomes more efficient than the other. Thus, not only temperature extremes, but even subtle variations in temperature can be critical to an animal's survival.

The oceans, where life evolved, provide a relatively stable thermal environment where organisms can live without much stress. The land, however, experiences great swings of temperature, both daily, as the surface of the earth heats up from the sun's warmth and then cools down at night, and with the yearly cycle of the seasons. In order to move out of stable ocean environment onto the land, life forms had to develop strategies to cope with terrestrial temperature extremes.

The simplest way to cope with an adverse climate is to simply

"not be there" when it gets too hot or too cold. Many of the simpler forms of life--bacteria, fungus, yeast--stop metabolizing, essentially stop living, when the temperature is inhospitable. Yeast can be dehydrated and stored in a refrigerator almost indefinitely. Put it back into 90°F water and they come most prolifically alive. Many plants and insects solve the problem similarly: they only live during the most favorable season, and leave seeds or eggs behind after they die that will not sprout or hatch until the next good season arrives.

If, however, an individual organism is to survive through a yearly cycle of seasons itself, then it must employ some thermal strategy more sophisticated than simply "not being there". Being deciduous enables many species of plants to survive through an adverse season, not only in snowy climates, but in desert climates as well. By dropping all of their leaves, they reduce their exposure to the temperature extremes. Their metabolic activity, which continues, but at a greatly reduced level, is confined to some protected core or roots sheltered underground. Cold-blooded animals, and a few small mammals, have a similar strategy to deal with extreme cold: they hibernate. The metabolic rate of cold-blooded animal, or any organism for that matter, is closely tied to the temperature of their body. As the temperature rises they become more active, and as the temperature falls, they become sluggish and lethargic. When the temperature becomes too cold, cold-blooded

animals simply give up the effort to continue to function and go into hibernation. Like the deciduous plants, they retreat to a place sheltered from temperature extremes, a nest underground or within the insulating wood of a tree. As their body temperature drops to ambiant their metabolic rate is greatly reduced, conserving energy for surviving through the dormant period.

Cold-blooded animals, however, have surprising abilities to maintain a steady internal body temperature in spite of external temperature swings. Their great advantage over plants is that they can willfully move about. This ability to move affords them two additional strategies to cope with unfavorable temperatures. The first is to willfully vary their muscular activity and thus, their body's heat production. On a cold day, butterflies will vibrate their wings for several minutes to warm up their muscles enough so they can then fly. The second strategy is to move to a location with better thermal conditions. Snakes sluggishly crawl out of their holes to bask in the morning sun, warming up before they begin their day's activities. By combining these two strategies, some species of lizards can maintain their body temperature within $1^{o}F$ of their optimum: to warm up they do "push-ups" on a sunny rock; to cool down they retreat to a shady crevice and lie still. Such strategies allow the animal to continue to function over a wider range of thermal conditions.[1]

Both of these strategies are also important for human beings.

They can consciously vary their muscular activity to increase or decrease their heat production. Stomping up and down, rubbing hands together, even going for a brisk walk are ways to generate some warmth on a cold day. In hot climates, the cool morning is usually the busiest time of the day, while during the hot afternoon people slow down, often taking a siesta to reduce their activity, and thus, their body's heat production, to a minimum. Such thermal responses even translate into seasonal patterns: thus, in New England, hot August is the season for vacations, for lazing on the beach, while with the coming of cold weather in the fall come more vigorous activities such as football games, chopping wood, or a brisk walk in the woods.

It is the genius of warm-blooded animals, birds and mammals, that they evolved a system that takes advantage of the heat generated by their bodies to automatically regulate their internal temperature. Shivering can produce more heat in the muscles. Mammals can also acclimatize to cold over a longer period by actually increasing their overall metabolic rate. The rate of heat loss from the body can also be controlled through a number of mechanisms. Panting or sweating allow for evaporative cooling from the mouth or skin. The flow of blood in the capillaries of the skin can be increased or restricted in order to control heat loss from the body's surface.

In addition to these metabolic responses, warm-blooded animals have another very important method to regulate heat loss. This is

with the variable insulation afforded by subcutaneous fat, fur, or feathers. Fat, which is only used as food-energy storage in other animals, is used by many mammals as a special insulating layer under the skin. Its thickness can be varied with the season to protect against extra cold. Polar bears and husky dogs have such an effective layer of fat that they can comfortably sleep on ice. Human beings, too, have this subcutaneous fat which thickens in response to cold. Both fur and feathers can provide exquisitely variable insulation. Smooth and sleek and a bit oily in summer, they protect the animal's skin from the sun's hot rays. In winter an extra downy undercoat is grown and can be fluffed-up at a moment's notice.

In the course of evolution, human beings lost the thick mammalian fur coat, and with it, its capability of thermal control. Our naked skin functions adequately in the hot, humid tropics, but needs some assistance in other climates. The clothes of various cultures often have very sophisticated thermal functions. The loose white robes of the Arab protect the skin from the sun's heat while allowing air to circulate to increase evaporative cooling. At the other extreme, the fur parka of the Eskimo keeps in both body heat and water vapor from perspiration such that the Eskimo essentially lives within a semi-tropical thermal environment. Clothes enable us to carry around with us our own specially modified little climate.

Mammals also make good use of the second strategy of cold-blooded animals, that of moving to the location with the most

favorable thermal conditions. Animals that are good travelers, such as birds and large herd mammals, can cover great distances in quest of a better climate and more plentiful food supply. A human parallel to long animal migrations can be seen in the tradition of the summer house in New England. Many families maintain a light, uninsulated cottage somewhere along the Atlantic coast with its cool sea breezes, or up in the cooler northern states. There, on weekend visits or for a whole summer's vacation, they find relief from the hot city and delight in the pleasures of the countryside. With air travel, wealthy families even extend this migration system to include a mid-winter trip to Miami or the Bahamas to escape the bitter January cold.

Migration, however, is an expensive solution, whether in terms of the energy an animal must expend to travel long distances, or in terms of time and money which people must spend. And before cars, trains, and airplanes, migration was extremely slow. Pre-industrial people couldn't travel very quickly, especially when moving a household. Ralph Knowles gives a good description of the seasonal migrations of the Piute Indians of the Owens Valley in California. Note that the total distance traveled is only thirty miles round-trip:

> "From permanent settlements, generally located in the most favorable microclimate, including a good water supply, the Piutes made seasonal migrations as village groups. Each summer, as the days began to lengthen and the temperature began to climb, the group moved west into the higher meadows of the Sierras. Here they enjoyed the coolness of an increased elevation.

> As the fall approached and passed into early winter, they migrated ten to fifteen miles to the east, where they gathered pine nuts at the base of the White Mountains. Here they were at a lower elevation and had a west and somewhat south exposure adding to their comfort as the winter days approached. The seasonal cycle was finally completed when they returned to their permanent campsite at the base of the Sierras to live out the winter in the relative comfort of huts that could be heated fairly well."[2]

Nest-building is, in a way, a more advanced version of choosing the best microclimate. An animal which seeks out a rock crevice or hole in the earth as a place to rest and get cool is indeed seeking out a favorable microclimate. Digging the hole a little deeper or adding a bit of shed fur for insulation are simple improvements. All animals start their nest by finding the best location, and only a few of the most talented nest builders--such as some birds, beavers, and Homo sapiens--can completely transform an environment to meet their nesting needs. The Anasazi Indians of the southwest United States were remarkably clever in choosing the sites for their cliff dwellings. They invariably chose locations which were shaded in the summer by an over-hanging ledge of the cliff, but exposed to full sun all winter long. With their backs to the cliff, the dwellings were protected from the winter winds, and could also take advantage of the thermal mass of the earth to moderate the temperature flux.

Buildings, even in the conventional ways we now build them, can be looked on as a way to modify the landscape to create more

favorable microclimates. As soon as a simple square hut is built, at least six new microclimates are created: the south side warmed by a sunny wall, the north side shaded most all the time, an east side with its morning sun and perhaps protected from the prevailing breeze, and a west side warmed in the afternoon but buffeted by the wind. Then there is also the inside with its shelter from the rain and wind and sun, and the roof, raised above ground level to be more exposed to wind and sun. The building increases the available range of thermal zones from which people can select the microclimate most suited to their thermal needs.

Many peoples of North Africa make use of both daily and seasonal migration patterns within their buildings to take advantage of the various microclimates which the building creates. In Tunisia, for example, the traditional two-story house encloses a central courtyard which has colonnades along all sides. In the summer, when the sun is high, the colonnade creates a deep shade. The family spends the day in the interior rooms of the first floor, where the thermal mass of the building best protects them from the sun's heat. At night, they move out onto the open roof, which quickly loses its heat to the clear night sky. In the wintertime the pattern is reversed. The family spends their days on the roof and the upper logia where the winter sun can still reach to warm them. At night they retreat to the rooms of the upper story whose walls have retained some of the heat from the day's sun, and where they can take

advantage of any heat rising from below.[3]

Vernacular building traditions all over the world display remarkably sophisticated thermal performance. Primitive builders consistantly used forms and materials which would effectively moderate prevailing climatic conditions. In the desert the characteristic problem is extremely high daytime temperatures coupled with uncomfortably low temperatures at night. The ideal building material would have a high heat capacity in order to absorb solar radiation during the day and slowly reradiate it at night. "Clay and stone are high heat capacity materials; they are plentiful in the desert, and it is precisely out of them that primitive folk around the world make their buildings," writes James Marston Fitch, in an article on "Primitive Architecture and Climate."[4] One finds buildings of adobe, mud and rubble masonry, and thick clay mortar on twig mesh in the American southwest, in the Middle East, across Africa from the Nile Delta to the Gold Coast. Conversely, primitive peoples in the hot humid tropics built dwellings which reduced thermal mass to a minimum, using light materials such as bamboo and reeds, to avoid significant reradiation of heat. Ventilation was maximized to increase the potential for evaporative cooling by placing large openings in the walls, or by dispensing with walls altogether. Large roofs provided shade and shelter from the rains. Such dwellings can be found throughout the South Pacific, the Caribbean, and among the Seminole Indians of Florida. This is also the basic approach of the Japanese

in coping with humid summers; it lead to the classic Japanese house, with its removable paper walls and great sheltering roof.

A particularly ingenious response to climatic needs is seen in the Eskimo igloo. Fitch provides an analysis of the igloo's thermal performance which is worth quoting at length:

> "[The igloo's] hemispherical dome offers the maximum resistance and the minimum obstruction to winter gales, and at the same time exposes the least surface to their chilling effect. The dome has the further merits of enclosing the largest volume with the smallest structure; at the same time it yields that volume most effectively heated by the point source of radiant heat afforded by an oil lamp.
>
> "The intense and steady cold of the Arctic dictates a wall material of the lowest possible heat capacity; dry snow meets this criteria admirably, though at first glance it seems the least likely structural material imaginable....The insulating value of this shell is further improved by a glaze of ice that the heat of an oil lamp and the bodies of occupants automatically add to the inner surface. This ice film seals the tiny pores in the shell and, like the aluminum foil on the inner face of modern wall insulation, acts as a radiant-heat reflector. When, finally, the Eskimo drapes the interior of his snow shell with skins and furs, thereby preventing the chilling of his body by either radiant or conductive heat loss to the cold floor and walls, he has completed an almost perfect instrument of control of his thermal environment."[5]

Of all organisms, human beings have the greatest variety of thermal strategies available to them: from varying gross muscular activity to the fine-tuning of variable insulation and automatic metabolic responses; from migrating between climates to selecting and improving, even creating, a favorable microclimate. But human beings also have one transcendent advantage. Plants and the simpler

animals are completely dependent upon an external energy source, i.e., the weather, to provide the temperature levels necessary for their survival. Cold-blooded animals begin to make use of their own body energy to generate heat, and warm-blooded animals are masters at regulating this second source of heat. But human beings have a third mechanism, independent of the climate and their own metabolism: the use of fire.

The use of fire offers enormous potential to effect the thermal environment. Initially, it simply enabled people in cold climates to generate enough heat to warm their dwellings. But increasingly sophisticated technology, the use of fire as a source of power for machines, and the use of additional sources of energy, has allowed human beings increasingly more precise levels of control of all aspects of the thermal environment. Fascination with this potential of mechanical systems to control the thermal environment has impelled the development of this one thermal strategy, to the exclusion of almost all the other available strategies.

Histories of civilization often begin with the discovery of fire. There seems to be a general belief in the civilizing force of the warmth of fire, such as inspired Vitruvius to write:

> "The men of old were born like wild beasts, in woods, caves, and groves, and lived on savage fare. As time went on, the thickly crowded trees in a certain place, tossed by storms and winds, and rubbbing their branches against one another, caught fire, and so the inhabitants of the place were put to flight, being terrified of the flames. After it subsided, they drew near, and

> observing that they were comfortable standing before a warm fire, they put logs on and while keeping it alive, brought other people to it, showing them by signs how much comfort they got from it....Therefore it was the discovery of fire that originally gave rise to the coming together of men, to the deliberative assembly, and to social intercourse."[6]

The use of fire as a heat source, however, might have originally been quite secondary to its other uses: as a way to cook and prepare food, as a way to smoke-out pests and discourage predators, and on the most primal level, as a focus of mystical fascination. Warm and glowing like a little piece of the sun; growing, moving, and dying like some bodiless spirit, the fire seemed to have magical properties. It has even been hypothesized that some of the first efforts at building were to shelter the sacred fire from rain and wind.[7] Nevertheless, heating functions ultimately took on great significance.

Fireplaces in primitive and medieval Europe were enormously inefficient, likely causing as many heating problems as they solved. The common system was an open hearth in the center of the room. The smoke escaped out a hole in the gable. Flames were more valued than embers, but the large open fires consumed great quantities of oxygen, pulling the cold, outside air in through the cracks of the building as quickly as the heated air escaped up the chimney hole. The only way to benefit from the fire's warmth was to be sitting directly in front of it to absorb its radiation. Thus, the only time of the day when our ancestors could enjoy the fire's warmth

was when there were sedentary activities, or cooking, to do. The rest of the time they had to depend upon warm clothes and their own activity to keep them warm.[8]

Around the end of the Middle Ages the chimney began to come into common use, and the hearth moved from the center to a side wall of a room. The need for the chimney to be made of fireproof materials was, unfortunately, only learned by trial and error, for as Lewis Mumford notes: "...Originally, lacking proper materials, the poorer burghers were tempted to experiment with wooden chimneys."[9] People soon realized that a stone or brick chimney not only was safer but absorbed heat from the fire and reradiated it back into the room. To take advantage of this, masonry chimneys were made ever larger, especially in northern Europe, where they might include a huge fireplace and cooking oven and even a sleeping loft above.

When firewood began to be scarce, however, people looked for a heating system that would be more efficient than an open fire. England substantially ran out of wood for fires in the 1600's, as the forests were appropriated for ship building and making charcoal for metallurgy.[10] The English were exceptionally fond of their open hearths, and reluctant to change to the more efficient system of coal fires and closed stoves, which were already in use on the continent. They persisted in using fireplaces, even though improvements in their efficiency were made only gradually. The greatest impetus for improvement came from the United States in the eighteenth

century with Benjamin Franklin's stove and Count Rumford's efforts to make a science of fireplace efficiency.

The stove brought with it the revolutionary idea that a fire could be used to heat the air indirectly and that the warmed air could then circulate to keep the whole house warm. It initiated the changeover from a radiant to a convective system of heating. For the first time the building was looked upon as the enclosure of a bubble of warm air. It was realized that attention had to be paid to making the building more airtight. Simply blocking out the rain and wind wasn't sufficient in an air-heated house, for if a building still freely "leaks" air, it is impossible to heat, especially in windy weather.

The new scientific understanding of convection and radiation processes brought a flurry of effort to design the perfect furnace--safe, efficient, and inexpensive. Natural, or gravity, convection was most commonly used to move the warmed air through the house, but pressure differentials and temperature stratification tended to create a very uneven distribution of the heat. Steam heat looked promising for awhile because it solved the problem of moving the heat from where the fuel was burned to where it was actually wanted. The steam could be piped under its own pressure, and then on losing its heat, condense back to water and return by gravity. Steam radiators, however, were noisy and excessively hot. With the development

of small, efficient electric motors, the heat distribution problems were more easily and comfortably solved. Small electric pumps could now move more warm water noiselessly through baseboard convectors, and electric fans could blow warmed air throughout the building. In addition, these motors could be easily and reliably controlled by simple thermostats capable of maintaining steady temperatures with no attention from the occupants.[11]

By the early twentieth century, the technology of heating with mechanical systems had been pretty well worked out. But heating is only half of the climate control problem, and by far the easier to solve. It is simpler to generate and retain heat where it is needed than it is to get rid of it in order to make a place cooler. In hot, dry climates people had long used evaporation as a way to cool the air. Systems of fountains, plants, and even clay pots filled with water, were used to both cool and humidify the air. But in humid climates, evaporation is inhibited, and even radiational cooling to the night sky is greatly reduced. This made it nearly impossible to cool a place in hot humid weather until, of course, the advent of air-conditioning technology.

Willis Carrier, the father of air-conditioning, began this revolution when he figured out a way to precisely control the humidity level of an air system. By cooling the air with a chilling spray of temperature-controlled water he could select the dew point temperature at which the water vapor would condense out of the air onto

the surface of the water spray droplets. He then reheated the air to the desired temperature, and thus obtained air at both the exact temperature and humidity that he wanted. As Raynard Banham points out, with Carrier's discovery, for the first time, all the elements of thermal control were available.[12]

Once the technology to completely control the thermal environment was developed, people became curious about what a truly optimal thermal environment might be. A great deal of research has since been done to determine the effects of temperature upon human beings, and to pinpoint the "comfort zone" where a person functions most efficiently, unhindered by thermal discomfort. It has been found that people are surprisingly sensitive to subtle changes in temperature. Givoni describes experiments that test sensitivity to still-air temperature using a scale from 0 to 9, which included such categories as very cold, cold, cool, comfortable, slightly warm, warm, etc. He writes: "Experience has shown that a person can distinguish not only between the various levels, but also determine intermediate levels such as 4.2 (not entirely comfortable, but definitely not slightly warm) or 4.7 (less than slightly warm, but definitely not comfortable) or 4.5 (somewhere inbetween). Every individual will have his own scale for evaluating his feelings, but the consistency of his own evaluations is good."[13] Similarly, studies have shown that people can sense very small gradations in the radiant temperature. In one experiment subjects were put in the center

of a room with a constant air-temperature, and with end walls whose surface temperature could be regulated. A majority of the subjects could notice a 5°C elevation in the temperature of the walls, a miniscule change in the mean radiant temperature![14]

Despite the level of sensitivity of perception, however, people generally have a wide range of thermal conditions in which they can be comfortable. Studies of "comfort zone", or zone of thermal neutrality, for lightly-clothed, sedentary individuals show considerable spread. Olgyay quotes a study that shows: "The British comfort zone lies between 58° and 70°F; the comfort zone in the United States lies between 69° and 80°F; and in the tropics it is between 74° and 85°F."[15] Without the standardized light clothing and low activity levels, one can assume that the spread of thermal conditions in which a person can be comfortable would be far greater. Such a comfort zone also varies enormously with each individual, and according to other factors such as age, culture, and acclimatization.

Despite this variation, the notion of a thermal optimum persists. The American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) has published standards for thermal comfort that are used across the country and have been incorporated into many municiple and state building codes. There is an underlying assumption that the best thermal environment never needs to be noticed, and that once an objectively "comfortable" thermal environment has been provided, that all of our thermal needs have

been met. The use of all of our extremely sophisticated environmental control systems is directed to this one end--to produce the standard comfort zone conditions.

A parallel might be drawn to the provision of our nutritional needs. Food is as basic to our survival as is our thermal environment. Just as thermal needs have been studied, so scientists have also studied the basic nutritional requirements of human beings. Our level of understanding makes it theoretically possible to provide for all of our nutritional needs with a few pills and injections. However, while eating is a basic physiological necessity, no one would overlook the fact that it also has a profound role in the cultural life of a people. A few tubes of an astronaut's nutritious goop are no substitute for a gourmet meal. It lacks sensuality--taste, aroma, texture, temperature, color. It is disconnected from all the customs which have developed around eating--the specific types of food and social settings associated with breakfast, with a family dinner, with a sweet treat. And it has none of the potential for significance of those special foods used for ceremonial occasions --such as a birthday cake, the Thanksgiving turkey, the symbolic foods of a Seder.

The thermal environment also has the potential for such sensuality, cultural roles, and symbolism which need not, indeed, should not, be designed out of existence in the name of a thermally neutral world.

Delight

People have a sense of warmth and coolness, a thermal sense, like sight or smell, although it is not normally included in the traditional list of our five senses. It is usually counted with other aspects of the sense of touch. They are taken as one, probably because the thermal sense is located in our skin where our sense of touch and pressure also lie. Or perhaps it is because we notice the temperature of something most accurately when we touch it directly, i.e., by conducting heat to or from it. But the thermal sense is definitely a separate sense, for we have nerve endings which are specialized to tell us if some part of our body is getting cooler or warmer.

As with all our other senses, there seems to be a simple pleasure which comes with just using the sense, letting it provide us with bits of information about the world around, using it to explore and learn, or just noticing. The stone is cool; yes, it feels cool when I touch it, perhaps it has been in the shade for a while. The coffee cup is warm, it warms my hands. There is something very affirming of our own life in being aware of these little pieces of information about the world outside us. When the sun is warm on my face and the breeze cool, I know it is good to be alive.

There is a basic difference, however, between our thermal sense and all of our other senses. When our thermal sensors tell us that an object is cold, that object is already making us colder. If, on the other hand, I look at a red object it won't make me grow redder, nor will touching a bumpy object make me bumpy. Thermal information is never neutral; it always reflects what is directly happening to the body. This is because the thermal nerve endings are heat-flow sensors, not temperature sensors. They can't tell directly what the temperature of something is, but rather they monitor how quickly our bodies are losing or gaining heat. Then, from this information, we judge how much colder or warmer than body temperature the object is. For example, if I touch a piece of wood and a piece of metal that are both at room temperature, the metal will feel colder because it absorbs the heat from my hand more quickly.

As long as the temperature differential isn't very great, our bodies can use one of their metabolic strategies to adapt to the new conditions, and the thermal stimulus will no longer be noticeable. Thus, when I walk into a warm room, I notice at once how much warmer the air is than the environment from which I came. Within a few minutes, though, I have adjusted and the room feels normal. Or rather, I feel normal in the room. We might draw a parallel with the "fatigue" experienced by the other senses (though the mechanism is not the same). We can only smell a rose for so long before the smell fades away. The sensors become saturated and attention moves onto

new information. Our nervous system is much more attuned to noticing change in the environment than to noticing steady states.

A proper gourmet meal has a wide variety of tastes--salty, sweet, spicy, savory--so that the taste buds can be renewed and experience each flavor afresh. This renewal seems to be especially true for the thermal sense when we experience a temperature change within the basic comfort zone. There is an extra delight to the delicious comfort of a balmy spring day as I walk beneath a row of trees and sense the alternating warmth and coolness of sun and shade.

We all love having our world full of colors, every color in the rainbow and then some. Even if studies have shown blue to be the most restful color, I doubt that anyone would put forth an argument for a monochromatic world. And yet a steady-state thermal environment is the prevailing standard for office buildings, schools, and homes across the United States. James Marston Fitch nicely sums up this ideal: "The technology of heating and cooling aims...to achieve a thermal 'steady-state' across time and a thermal equilibrium across space."* [1] In other words, a constant temperature, everywhere, at all times. He goes on to note that "Neither of these criteria is easy to achieve since radiant and ambient heat are very unstable forms of energy." [2] Such uniformity is extremely unnatural, and therefore requires a great deal of effort, and energy, to maintain. HVAC

*The energy crisis has provoked active rethinking of these standards.

engineers must use extremely sophisticated methods in order to insure that every location within an enormous office tower can be maintained at the same temperature and humidity.

It is not at all uncommon these days, in Houston or Los Angeles, to leave an air-conditioned car to work in an air-conditioned office, until it is time to go to dinner in the air-conditioned restaurant before seeing a movie in the air-conditioned theater. Of course, there is the brief inconvenience of a blast of hot air between the car and office. To remedy this, it is occasionally proposed that a large bubble could be put over the whole city, perhaps a pneumatic structure or one of Buckminster Fuller's domes. This "climatic envelope" would enable the entire city to be air-conditioned, indoors and "outdoors." Indeed, "outdoors" would be a thing of the past. This approach is actually being tried on a relatively small scale at a new General Services Administration Building in Colorado. A "landscape" of low rise structures will be contained within a transparent pneumatic bubble. The buildings then will need no windows or doors or individual mechanical plants, as the entire "landscape" is maintained at the same comfortable temperature.

The steady-state approach to thermal environment assumes that any degree of thermal stress is undesirable. A constant temperature is maintained in order to save people from the effort, and the distraction, of adjusting to different conditions. And yet, in spite of the extra physiological effort required to adjust to thermal stimuli,

people definitely seem to enjoy a range of temperature. Indeed, they frequently seek out an extreme thermal environment for recreation or vacations. This must explain in large part the love of the Finns for their saunas, and of the Japanese for their scalding hot baths. Americans flock to beaches in the summer to bake in the sun, and travel great distances in the winter to ski on a frosty mountain top. People relish the very hotness, or coldness, of these places.

We should note that all of these places of thermal extremes have their opposites close at hand. The Finns make a practice of jumping from the sauna into a snow bank or a cold lake. At the beach, after baking in the hot sun there is the cold ocean to swim in. The skier freezes on the slope, knowing all the while the lodge waits down below with a roaring fire and some warming libation.

There are probably two reasons for having the extremes right next to each other. The first is physiological: the availability of extremes insures that we can move from one to the other and maintain a thermal balance. This gives the safety to fully enjoy both extremes. We can be greatly overheated for a while, and then chilled to the bone, all without threatening our health. Indeed, proponents of the sauna claim it even strengthens one's health and improves resistance to cold. Viherjuuri, historian of the sauna, quotes an entertaining description from an Italian traveler of the eighteenth century who encountered some Finns after their sauna:

"In winter they often go out completely naked and roll

> themselves in the snow, while the temperature is 40 or 50 degrees below zero. They wander naked in the open air, talking to each other and even with a chance passer-by. If a traveler in search of help happens to arrive in a remote village at the time when all the inhabitants are in the sauna, they will leave the bathhouse in order to harness or unharness a horse, to fetch hay, or to do anything else without ever thinking of putting any clothes on. Meanwhile the traveler, although enveloped in a fur coat, is stiff with cold, and does not dare to take off his gloves. What astonishes the people of our climate most is that no ill effects ensue from this sudden change of temperature. People who live in warmer climates, on the other hand,...are liable to get rheumatism even when the most gentle wind blows."[3]

The second reason to have thermal extremes close by each other might be termed aesthetic. The experience of each extreme is made more acute in contrast to the other. We need not even directly experience both extremes in order to savor their contrast. Simply being reminded of the cold winter storm outside can make us enjoy the warmth of the fireside even more intensely, as John Greenleaf Whittier so vividly recounts in his poem "Snow Bound":

> "Shut in from all the world without,
> We sat the clean-winged hearth about,
> Content to let the north-wind roar
> In baffled rage at pane and door,
> While the red logs before us beat
> The frost-line back with tropic heat;
> And ever, when a louder blast
> Shook beam and rafter as it passed,
> The merrier up its roaring draught
> The great throat of the chimney laughed."

Perhaps here too lies a reason for the imperative that the garden in Islam was contained by high walls. The garden, with its flowers, shade trees, and fountains provided a cool refuge from the desert

lands. The bright sun and hot desert air could not be completely excluded, but the walls sharply defined the limits of the garden, and concentrated the sense of its lush coolness. Certainly, the high walls were a way to insure privacy, so important for the Moslem. Yet their highly visible presence also served to emphasize the difference between the cool garden within and the hot desert without.[4]

Since our thermal sensors are not distance receptors, i.e., they cannot warn us that a place will be cold before it starts to chill our body, we have to rely on other senses to give us advance clues. We look for qualities that have been associated with warmth or coolness in our past experience. Does the place have soft fuzzy surfaces? Perhaps it will be warm like my wool sweater is. Are the colors reds and browns? Then maybe it will be warm like a room lit by the red-gold light of a fire. Are there mellow aromas? Then surely it will be warm like a kitchen full of people and spices and bread baking.

Such clues from other senses can become so strongly associated with a sense of coolness or warmth that they can occasionally substitute for the real thing. For example, the taste of mint in a drink or food seems refreshing and cool regardless of what temperature it is. Similarly, in order to feel warm and cozy at night, many people find that they must have a heavy set of blankets to cover them while they sleep, even though one light, fluffy quilt would be a better insulator. The pressure of the blankets conveys a feeling of warmth quite independent of their actual thermal qualities. An example

related by Yoshida suggests that the Japanese are masters of the substitution of one sense for another. He reports: "In the summer the householder likes to hang a picture of a waterfall, a mountain stream, or similar view in the Tokonoma and enjoy in its contemplation a feeling of coolness."[5]

One of the magical things about our senses is exactly that they do not function in isolation. Each sense contributes to the fuller comprehension of other sensory information. Indeed, one may not even be able to properly understand the information from one sense until it can be related to information from other senses. For instance, a person blind from birth because of a congenital cataract, who then has sight restored by surgery, must learn to "see." At first the field of vision consists of light patterns, flat and meaningless. Gradually specific light patterns are associated with understandings about the world developed from other senses. In order to learn to see things three dimensionally they must be touched, rotated, walked around. By associating bodily movement, touch, and sight, the brain begins to perceive form and depth and perspective.

Looking at a photograph of a place, we are limited to purely visual clues about its thermal qualities, yet still we can perceive it to be a warm or a cool place, thermally pleasant or unpleasant. A picture of a mosque in Isfahan, for example, with its polished marble floors and heavy masonry walls, its high airy vaults and deeply shaded recesses, looks invitingly cool and refreshing. Of course, we imagine

it to be in the hot desert sun of Iran. With almost the same set of visual clues of coolness--heavy masonry, smooth polished surfaces, high airy colonnades--a building in Germany, such as one of the neo-classical government buildings of the 20's and 30's, translates as forbiddingly cold and inhospitable.

Our perceptions might mislead us completely. Both of the places could conceivably be heated by a hidden radiant system. With our current technology the temperature of a place need not be associated at all with the form of the building or the materials used or the region where it is located. But how unsatisfying is this dissociation of warmth or coolness from all of our other senses!

To enjoy being warmed or cooled we need some awareness of the process. Clearly, it is impossible to consciously enjoy what we can't notice, and yet, most of our processes of heat flow take place below our level of conscious sensation. Most of the processes of cooling, for example, are especially subtle. Heat usually convects away from our skin surface in air currents too gentle to discern. Similarly most perspiration evaporates before we perceive our skin to be moist. Clues from other senses can help make us more aware of the thermal processes, enabling us to derive more enjoyment from them.

For instance, there are many ways to notice that the air is moving and helping to cool us even when it is too gentle to feel. A Chinese poet expressed it well:

"You can't see it or hear it,
It is so soft. But it is strong enough
To dust the mirror with pollen,
And to thrum the strings of the lute."
Ho Hsun[6]

Yoshida reports that in the hot and humid Japanese summer "People like to hang a lantern or a wind chime under the roof of the veranda. The lightly swaying lantern or the ringing of the bell gives a suggestion of refreshing wind and coolness."[7] In Persian gardens roses and jasmine and other fragrant flowers were planted in different quarters so that when the breeze came it came "loaded with scents."[8]

Many of the other sensory associations with cooling seem to try to remind us of things, like the breeze, lightly playing over the surface of things. Cooling sounds are light and high pitched, like the Japanese wind chimes or the splashing of water droplets in a fountain. Cool decorations move lightly over the surface, like the latice work and laciness of a Victorian gazebo, or the vines and script that twine endlessly over every surface of a Persian mosque. Indeed, it is right at the skin's surface that people most consciously notice cooling. This makes perfect sense when we consider that both the processes of evaporation and convection take place at the surface of the skin. Even when losing body heat by radiation to a cold surface, people still assume that they are being chilled by a cold draft somewhere in the room. People also feel chilled, even to the point of getting goosebumps, if their skin is lightly touched, as with the brush of a feather, even though there is no temperature change at all!

In contrast, there is something basically internal about warmth, probably because we associate it with the warmth generated within our own bodies. Warmth is what's alive at the very core of things. A fire and the sun also generate heat inside of themselves. We feel their heat, not so much as warming our skin, but as penetrating into the center of our being.

Other than a fire or the sun, we are generally the warmest things in our environment, our own source of heat. Thus, when it is cold out, the way to get warm is to get inside of an insulator: to get inside of thick, fluffy clothing; to sink into a deep, overstuffed chair; or to huddle inside of a close-sheltering building. These are all just big enough to enclose our body, preventing its heat from dispersing very far away.

Other bodies, of people and animals, are also sources of heat. To be close to someone is to share in their warmth, both physically and emotionally. Places that speak of the presences of people, of the life and activities that they generate, capture some of this sense of warmth. The Victorian parlor, with all of its clutter, remnants of people's lives, deep upholstered chairs, and layers of rugs and curtains and hangings and pictures, has this sense of warmth to it. The sounds and smells of people all indicate their presence, and thus, their warmth. Things that were once alive and warm themselves, like the fur of a polar bear rug, or the leather of a chair, perhaps even the sheep's wool in a sweater, may carry an association with that

previous life and so seem even warmer.

When we get cold, our muscles tense up, trying to generate more heat, and capillaries at the skin surface constrict. These physiological responses leave us feeling tense and numb. Places that seem warm offer an antidote to the tension and numbness with things that are comforting and soothing: a soft, flowing light, the deep plush of a velvet chair, or the low resonant notes of a blues song. They help to relax us in the same way that the warmth of a fire, or even a drink of liquor, penetrates through the body and relaxes the muscles.

When we are overheated we often need the opposite antidote. The heat makes us lethargic and slow-witted. Any action requires too much effort. There is delight, then, to be had in things which provide a little liveliness for us, like the splashing of a fountain or the sparkle and flutter of Japanese street decorations. Their activity helps the mind feel a bit more quick-witted and lively in spite of the dullness of a hot, muggy day. A hot day, however, can also be stressful because it overstimulates. The sun can be too bright, glinting off of every surface, with an inescapable dry wind that exhausts the nerves. The antidote, then, is not something which moves and sparkles, but a deep, quiet coolness, a place to retreat from the sun and rest in peace. Deeply shaded Islamic prayer halls, with their seemingly endless repetition of columns and archs, produce this calming effect. The classical Persian garden is intended to provide the

antidote to both the lethargy or the exhaustion of senses. There is the liveliness of the fountains and the overhanging vines with their fluttering leaves creating a dappled light. But there are also places of still water, and large stone pavilions which create a deep, quiet shade. One is free to move among these different elements and to chose the place where the balance of liveliness and quietude are just right. The Persian garden offers an amazing richness and variety of sensory experiences which all serve to reinforce the pervasive sense of coolness.

Each sense not only gives us different information about the world, but also has its own quality, its own evocations. Yi-Fu Tuan has made some interesting correlations between the senses and one's perception of the world. The sense of smell seems to be somehow linked with our faculties of memory. Tuan writes: "Odor has the power to evoke vivid, emotionally-charged memories of past events and scenes. A whiff of sage may call to mind an entire complex of sensations: the image of great rolling plains covered with grass and specked with clumps of sagebrush, the brightness of the sun, the heat, the bumpiness of the road."[9] Or the same smell of sage often used in turkey stuffing, might call forth all of the warmth and intimacy of Thanksgiving. Sight is perhaps more difficult to categorize because it functions on so many complex levels. But clearly, it is most important to our spatial understanding of the world. It allows us to see three dimensionally, to judge distance, and thus, to

understand the relationship of one thing to another. In English, "I see" means "I understand." But vision is also rather static. Although we see motion, we tend to visually remember only a fixed image, unlike a song which must be sung in time. Hearing, on the other hand, seems to be strongly associated with a sense of time. A song, or a melody, to be remembered, must be remembered in time. Tuan writes: "With deafness, life seems frozen and time lacks progression."[10] The sense of touch has an immediacy to it. If we can touch something we are persuaded that it is not an illusion, or a hallucination, but that it is very real, "right here and now"--like pinching yourself to see if you are dreaming. The thermal sense cannot be easily isolated from overall experience, like seeing or hearing. We cannot close it off, like closing our eyes. Nor does it provide highly differentiated information, such as the individuality of a person's voice, or even their smell. The thermal sense is, however, intricately bound up with the experience of our bodies. We continually sense the heat flow of our bodies, information which creates a general background for all other experience.

Since each sense contributes a slightly different perception of the world, the more senses are involved in a particular experience, the fuller, the rounder, the experience becomes. If sight allows for a three dimensional world, each other sense, then, contributes at least one, if not more, dimensions. The most vivid, the most powerful experiences are those which involve all of the senses at once.

Perhaps the human fascination with fire stems from the power of the totality of its sensory stimulation. The fire gives a flickering and glowing light, ever-moving, ever-changing. It crackles and hisses and fills the room with the smells of smoke and wood, and perhaps even food. It penetrates us with its warmth. Every sense is stimulated, and all of their associated modes of perception, such as memory and a sense of time, are also brought into play, focused on the one experience of the fire. Together they create such an intense sense of reality, of the "here and now-ness" of the moment, that it becomes completely captivating. We are likely to feel that we could spend hours mesmerized by the fire. Indeed, Gaston Bachelard makes an eloquent case that "Reverie before a burning fire is...the first and the most truly human use of fire."[11]

Islamic gardens, also, offer delights for each sense, and they seem to have a power similar to that of fire to captivate the imagination. A Turkish garden motto states clearly the provisions for the senses:

> "Roses for perfume,
> Nightingales for song,
> And the sight and sound
> of running water."[12]

A sixteenth century traveler furnished an eyewitness description of the delights of a Persian garden during their golden age:

> "The garden I shall describe was constructed in such a way that two courses of crystal-clear water met before a building, forming a large lake in which countless swans, geese and ducks disported themselves. Below

this lake were seven waterfalls--as many as there are planets....From the lake jets of water spouted up so high into the air that the spray, as it descended, was like a rain of diamonds. How often was I moved by the rippling of the fountains and the murmuring of the brook as it streamed downhill, over the terraces of the garden, hemmed in by rose bushes, willows, and acacias. I cried with sheer joy until the exceeding beauty and the rushing of the water rocked me to sleep."[13]

Affection

Keeping warm, or keeping cool, has been an everyday activity for people since time immemorial. But it exists at an almost unconscious level of culture, for the actions are so common, and usually so well integrated with all the other aspects of the culture, that people don't often notice their particular character as a response to thermal need. It is only the rare literary traveler who may remark how a peoples' customs are suited to the local climate--a subject for travel essays only slightly more sophisticated than remarking on the weather itself. And yet from the minute scale of gesture and posture, to the grand scale of ritual and festivals, social customs often involve a thermal aspect. The image of a Southern lady nervously fanning herself is that of a coquette using the fan as a prop for flirting, rather than a woman merely trying to cool herself. Europeans have the custom of using furniture, chairs and beds, which conveniently raise them above the cold air that accumulates at the floor level. Hindus, on the other hand, use no such furniture, but sit directly on the floor, where they benefit from the extra coolness held in the ground. Christmas is known as a religious festival. Yet the notion of celebrating Christmas in the southern hemisphere at the height of mid-summer heat is slightly unsettling to us in the northern

hemisphere. In spite of its religious rationale, Christmas has strong connotations of being a warm, cozy time set in contrast to mid-winter cold. Similarly, in every culture, each season has its set of rituals, customs, and special activities associated with it.

In agricultural communities the world over the life of the people has always changed radically with the seasons. Not only were different crops to be cared for, but other jobs, rituals, clothes, and festivals were all associated with the particular weather and thermal conditions of each season. John F. Embree, in his study Suye Mura, a Japanese Village, presents a chart which details how all of the jobs to be done in the village have a special seasonal time slot. He explains: "In addition to the seasonal nature of sowing and harvesting the crops, there is a set season for making most of the village's products. A year's supply of hair oil is pressed in spring before the work of wheat harvest and rice planting begins ....Each season has its characteristic clothing, even the games children play are seasonal--girls bounce balls in fall and juggle bean bags in the spring; boys chase dragon flies and walk on stilts in the summer....The only aspect of life in the [village] not directly or indirectly affected by the seasons are those works of fate--birth and death."[1] Obviously, much of this was determined more by the cycles of plant and animal growth than determined directly by temperature; but the thermal conditions which coincide with these cycles are inextricably associated with the activities and rituals, and

serve to reinforce their importance.

In the same way that customs can come to be associated with seasonal and thermal qualities, many seemingly mundane objects in our lives may also have strong thermal associations. Tea pots are warm things, because they hold hot tea. Yet even when they are empty they have a sense of warmth which lingers about them. The toddler who drags his security blanket everywhere may love it most as a reminder of the sense of warmth and well-being it gives him in his bed, not so different from the security and warmth of being held by his mother.

Like the toddler, we tend to cherish the things which have provided us with warmth, or coolness, just when we needed or wanted it. This association between an object and our thermal well-being may become semi-conscious and vague, and yet it can strongly contribute to our affection for the object. How hard it is to give up the old misshapen sweater, or the old shade hat which kept the sun off for so long. They are rather like old friends who have done us a good turn over and over again.

Places are especially likely to have thermal associations, for the provision of shelter, or the creation of a favorable microclimate, is one of the most basic functions of building. A place with strong thermal associations may be the sort of place we use everyday, like a breakfast room where the sun streams in each morning, or it may be somewhere we only go for special occasions, like a shady park pavilion for summer picnics. It might even be a place we have never

experienced directly but that we can fantasize about as having wonderful thermal qualities. A mountain cabin deep in the winter snow can convey a sense of cozy shelter, even when it is just an image in a photograph.

The fondness which many Americans have for the four-poster bed may be simply because it is a nostalgic reminder of the colonial era, like turned maple furniture, or an eagle over the front door. Yet there is probably also an awareness that it provided a cozy retreat where one was assured of finding warmth and comfort. With its canopy, and curtains which could be drawn to prevent drafts and retain body-warmed air, the four-poster bed was a valuable enclave within the cold, and drafty, old houses.

The inglenook, the gazebo, and the porch swing are other examples of places with a special thermal function. The inglenook, often more of a small room enclosing the fireplace than a "nook," was an old Medieval English device that was revived at the turn of the century by Frank Lloyd Wright, C. F. A. Voysey and their contemporaries.[2] Like the four-poster bed, an inglenook creates the image of a special warm enclave, for its function is intuitively clear: with seats built in along the walls, it is just large enough for a few people to gather close to the fire's radiant warmth and be shielded from drafts.

The airy Victorian gazebo was perhaps the thermal antithesis of the inglenook. With an open structure and a light, umbrella-like

roof, the gazebo was set out on an open lawn where it could provide a bit of shade while catching every passing breeze. Usually painted white, with lacy Victorian scroll-work, the gazebo designated a certain spot as the cool and shady place to be on a hot summer's day.

The American porch swing is another interesting example. Now, the creaking, wood-slatted swing out on the front porch may be something of a cliché as a setting for courtship in the South, but until the availability of air-conditioning, it was a thermal necessity. The swing was a most effective way to get a bit of cooling ventilation to relieve the heat in the still, sultry nights of the American South. Instead of fanning oneself, the gentle swinging moved air past the entire body with very little effort expended. It is little wonder that such a pleasant system of cooling provided a favorite place for visiting and courting.

The inglenook, or the gazebo, may seem more like the setting for a children's story than an example of a thermal environment relevant to today's needs. Yet the very affection with which they are remembered, revealed in the bits of romance or nostalgia which get attached to them, suggests there is something of value to be learned from them.

The words we use to describe such places--snug and cozy, or airy and refreshing--all imply that these places offer us a sense of thermal well-being. And it is partly this association of an experience of well-being with a particular place that leads us to think of it

fondly. As with the toddler's blanket, or the old sun hat, we can develop an emotional attachment to the places that have been responsible for pleasant moments in our lives.

Fondness for a particular place or thing is often manifested in the extra care which people invest in it, especially via decoration. The elaborate and colorful patterns of a patchwork quilt suggest that it is well-loved by someone. The decorative designs often embossed on a wood-burning stove indicate it is not regarded merely as a functional appliance, but as a special object deserving a little extra attention. Similarly, the choice of the mantle as the place for precious objects that a family wants to display bespeaks the importance of the hearth in the family's life.

We need an object for our affections--something identifiable on which to focus attention. If there is something very individual and particular which we consider responsible for our well-being--a stove which is the source of all warmth--we can focus appreciation for our comfort on that one thing. But if nothing seems to be responsible for our sense of well-being, then what or whom, do we thank? On a lovely spring day we may identify the season itself with our wonderful sense of well-being, just like the hundreds of songs that rhapsodize their love of Spring. On a tropic isle that has an ever-perfect combination of balmy breezes, warming sunshine, and shady palms, we would probably come to love the island for providing us with such a fortuitous setting. But in a typical office building, to what does

one attribute the all-pervasive comfort of 70°F, 50% RH.? The air diffuser hidden in the hung ceiling panels? The maintenance personnel who work during off-hours? The mechanical equipment down in the basement, below the parking garage? The engineer who designed the system long ago? The whole vast building itself? Most likely, we would simply take it all for granted. When thermal comfort is a constant condition, constant in both space and time, it becomes so abstract that it loses the potential to focus affection.

We are also unlikely to relate our thermal well-being to anything in particular unless there is an awareness, at some level, that an object or place does indeed have a thermal function. Radiant hot water pipes embedded in a ceiling may do an admirable job of keeping us warm and comfortable, yet there is no way to sense directly that the ceiling has a thermal function. The radiant level is generally far too gentle to notice, nor is there any way to see or hear or feel that the ceiling is "on." The lack of specific clues make it hard to relate to the ceiling in the same way we relate to, say, the hearth.

The same can be said of walls. An important function of the exterior wall of a building, especially in a cold climate, is to act as an insulator between the interior of the building and the weather conditions outside. To improve the thermal performance of modern light-weight construction, we stuff the wall with a thick blanket of fiberglass fuzz. The insulation is then completely covered over with finish materials, so that only someone who had built the wall would

be aware of its anatomy and thus be able to fully appreciate it for its thermal abilities.

Compare this to a highly visible system of insulation from the Middle Ages--the use of exquisite, intricately woven tapestries and carpets in the great medieval halls. The practice originated with the European peasants who would hang skins or lengths of cloth on the walls of their houses during the cold weather. This created an extra insulating air space and a radiation barrier between the inhabitants and the cold exterior walls. Eventually the royalty took to commissioning the weaving of very special pictorial hangings, the tapestries, to grace the ever-cold stone walls of their castles. Such tapestries clearly transcended their role as insulators and evolved into one of the high art forms of the period.

The Mughuls of India developed a similar system in order to make their open and airy stone palaces heatable in the winter. Collections of Persian carpets, in addition to providing insulating layers over the stone floors for people to sit on, were also hung from hooks along the walls. Sometimes hung two thick, the carpets created an insulating tent within the room, whose richness was certainly fit for a sultan. The carpets were greatly valued for their beauty, but also for the sense of warmth and comfort they conveyed. Their removal when the warm weather arrived reinforced their seasonal and thermal associations.[3]

One of the factors that can help us to appreciate the thermal

function of a place or object is variability. We are more likely to notice the function of something if there are times when it is not in operation; to notice the significance of something's presence if there are times when it is not there. Shutters provide an interesting example. Outside window shutters have long been common all over Europe, and were a standard feature of buildings in early America. Their function, clearly, is to close off the window and so to shelter the interior of the house from storm winds or from excess heat. Most of the time, however, they are hinged open, hanging at the side of the windows. Even while open, their presence conveys a reassuring sense of shelter, for there is the implication that they could be closed when needed. This sense of shelter even continues with shutters that are only decorative, as are the hopelessly narrow shutters which frame modern picture windows on houses all over the country. For many people, a house simply does not look friendly or comfortable without shutters framing its windows. In contrast, the wall of a house has many of the same functions as a shutter--to keep out storm winds or excess heat--and yet, we are unlikely to appreciate a wall for those particular functions for it does not go through any changes that would draw our attention to its performance.

Related to shutters are the various systems of movable insulation that are being developed in conjunction with solar design. They would seem to have a similar potential for becoming objects of people's affections. Their relation to thermal function is quite obvious

because they are only in place when extra insulation is needed. Two especially friendly systems are coming into use. One is a rolldown shade using either quilting or a thin sheet of foam rubber, covered with a decorative fabric, which is held snug against the inside of a window frame with strips of velcro. Pulling down these shades becomes a bit like putting the house to bed at night. The second is an insulating louver system developed by Zomeworks Corp., called "Skylid."[r] The louvers automatically open to let solar radiation in when the sun shines, and then close in the evening to prevent radiant heat loss. They are ingeniously controlled and driven by the shifting weight of Freon which alternately vaporizes and condenses to shift the balance of the louvers. Louise and Janius Eddy, a couple that have installed some Skylids in their house to assist in solar collection, describe how the louvers have heightened their awareness of thermal processes. "We look into the greenhouse and watch the skylids closing automatically, one by one and in no particular order, and we are aware of hot air rising, cold air settling....[They] remind us that the earth is turning and the day is ending."[4]

The most direct experience of a thermal process is via conduction, for, as mentioned in the previous chapter, the sense of touch has an immediacy and undeniable reality to it. Whenever we touch something, we simultaneously receive information about its temperature, whether we consciously take note or not. Our affection for many everyday objects may derive partly from simply enjoying their

warmth or coolness as we touch them. An Englishman's fondness for his pipe may come in part from cradling its warm bowl in his hand. A pet cat provides a warm body to stroke, and creates a pool of warmth as it curls contentedly in one's lap. (Don't be flattered, she is just after your warmth!)

Conduction can also play a role in our relationship to the larger environment. The most commonly experienced conductive environment is water. When we immerse outselves in water, its temperature is always an important consideration because we exchange heat with it so quickly. People are very careful about how cold their cold bath really is. They have a wide range of descriptions for water temperature, from tepid and lukewarm to scalding. In Northern China and Korea there are raised earthen platforms inside the houses, called a k'ang. Heated by the flues from the kitchen stove that are buried within, they provide a warm surface on which to sit. It is on the k'ang that the family sits to eat meals, to do household chores, and to spend their leisure time in talking and telling stories. Sand dunes in Saudi Arabia are another interesting example of a conductive environment. In the villages, people commonly go out in the evening to sit and talk on a nearby sand dune. On a hot night the north slope of a dune offers a very comfortable and cooling place to sit. When the nights get cooler, people choose instead to sit against the slope which is still warm from the late afternoon sun.[5]

On the whole, though, conductive environments are rather rare.

Instead of the immediacy of conduction, our thermal relationship with a place is more likely to be through convection, evaporation, and radiant exchange. We may note these processes in the extreme cases --the very hot air of the sauna is unforgettable, or the radiant heat from a very hot source such as a stove, a fire, or the sun, is certainly noticeable. But more often these processes operate below our consciously sensible level. We may still perceive a place to be warm and comfortable, or cool and relaxing, but without necessarily noting exactly why or how. The thermal information is not differentiated in our memory, but rather is retained as a quality, or underlying tone, which is associated with the whole experience of the place. It contributes to our sense of the particular personality, or spirit, that we identify with the place. In remembering the spirit of a place, we can anticipate that if we return, we will have the same sense of comfort or relaxation as before.

The four-poster bed provides a good example of a place which is not warm of itself, and yet carries strong thermal associations. It slowly becomes warm as the air within the drawn curtains is warmed by body heat. While such a thermal process is a bit subtle to perceive, the overall experience of warmth can be related to the context of a very distinct and identifiable place. The limits of the space are clearly marked by the four posts which frame the bed. The space is further enclosed by the curtains hung from the frame. Such strong spatial definition insures that our memories will associate the

experience of thermal comfort with something in particular--the place itself.

The inglenook, the gazebo, and the porch swing are likewise small places that have strong definitions of their spaces. They are each a bit like a "little house" set off for a special thermal purpose. They might be termed "thermal aediculae." Although the term aedicula is most often used in conjunction with a sacred or ceremonial "little house," it can also be used to describe any diminutive structure which is used to mark a place as special. Summerson, in his wonderful essay on the use of the aedicula in Gothic architecture, relates the aedicula to the common urge of the child to hide under a chair or table and pretend that he is "in my house." He contends that there is a basic human "fascination of the miniature shelter."[6] Perhaps this is because the aedicula intensifies one's experience of the place by working somewhat like a caricature. By reducing some things in scale, it exaggerates the importance of other things, most especially the size of a person in relation to the space. Making thermal places that incorporate the qualities of an aedicula is a way to emphasize the importance of the place as a setting for people.

Special little thermal places, like the inglenook or gazebo, now seem rather quaint and old-fashioned because they have been outmoded by a technology which enables us to keep whole buildings at a uniform temperature. We no longer need to create the one special place which will have just the right thermal qualities, for every

place can now be "just right." Yet the lingering fondness which we have for such places suggests there was some need they served especially well.

Each one provided a setting for the activities associated with a specific set of thermal conditions. People's daily habits and spatial patterns were in large part determined by where desirable thermal qualities were available. In southern Italy women often do their sewing sitting in the open doorways of their houses where they can make subtle adjustments of the position of their chairs according to how much sunlight or shade, warmth from the sun or coolness from the house interior, they desire.[7]

In America, our tendency has been to get away from thermal conditions as a determinant of behavior. Instead, we have used our technology to keep entire living and working complexes at a uniformly comfortable temperature. As a result, our spatial habits have diffused and activities that were once localized by thermal conditions have spread out over the whole house or building. We forget, unless the system breaks down, that such wide-ranging use of space is extremely dependent upon the available heating and cooling equipment.

Lawrence Wylie, a Harvard anthropologist, tellingly describes how his family had to readjust their entire domestic pattern when they left their modern American home, "where a movement of a finger regulates the heat of the whole house," to live in a French village. He writes:

> "There were fireplaces in every room; there was the kitchen stove; there was a salamander--a kind of franklin stove--in my study. I was determined to keep the house warm, since with all this apparatus it was theoretically possible. For a few days I went from stove to fireplace to salamander to furnace, nourishing the various fires with wood and coal briquets. It did not take me long to discover that it was a full-time job to keep all these fires burning....Even by spending time and money to heat the house, I was not accomplishing my purpose. When the mistral blew, no fire could keep my study warm. I gave up heating it and brought my typewriter and books and papers into the salle. Then it seemed foolish to have fires going in the fireplaces in the bedrooms when the only times they were useful were when we were dressing and undressing. It was more sensible to dress and undress in the salle. The bathroom was no longer a comfortable refuge as it was at home....We found that we needed fewer baths than before....When one of the children had an earache at night we could not sit in his room and rock him; we brought him down and held him on our lap in front of the fire. The fire of oak logs which burned day and night for six months became the focal point of our family life."[8]

Their spatial behavior, indeed, all of their behavior changed in response to the new (old) heating system:

> "Little by little, our family life, which at home was disturbed throughout the entire house and which we had tried to distribute throughout the Peyrane house, withdrew from all other rooms and was concentrated in the salle....I had to learn to work while the children were playing. The children had to learn to play more quietly. I had to learn to pick up my paper from the table so that it might be used as a dining-room table....Without realizing it we had adapted ourselves to a necessary condition of life in Peyrane where families learn to live together in one room....It is inevitable that the English word "home" cannot be translated directly into French. The nearest equivalent in French is the word foyer, the hearth."[9]

There were also seasonal patterns of space use that the family

found significant: "In the summer this center of life is less important. The fire is lighted only to cook the food. The family lives outdoors in the sun as much as possible."[10] Thus, in the summer, social life becomes much more public, moving out into the village streets and plazas, to open-air cafes and boule courts, where either warming sun or cooling shade could be found, as necessary.

The great fondness of Mediterranean cultures for their streets and plazas is largely thermal. A great deal of social life goes on in the streets and plazas because they offer the greatest thermal comfort. They provide a place to bask in the sun, or a shady and airy place to be cool, while the houses are stuffy and either too cool from the night before or overheated in the afternoon. In most Mediterranean countries the custom of an evening promenade, or paseo, exists to take full advantage of the pleasant coolness of the streets and square in the summer's evenings. After the sun has set and the heat of the day is broken, people emerge from their houses and work, groups of young men or young women, old people with their grandchildren, whole families together, and take a stroll along the via and piazza to see who they may see, to stop and talk, but most simply, to enjoy the pleasant air.

Places with desirable thermal qualities naturally tend to become social spaces as people gather to take advantage of the comfort to be found there. Examples of places with important thermal qualities that are also social spaces abound in every culture. In Saudi

Arabia mosques are designed with a special basement prayer hall that stays cool during the hottest Saudi days. In addition to being used for prayers, it is also a favorite place for the men to stay to socialize or take their afternoon nap."[11] For the women of southern Italy the baker's shop is the place to gather for gossip in the winter, for the ovens make it the warmest place in town.[12] In nineteenth century America each farmstead or town was likely to have an ice house for storing the ice harvested from a pond for use during the summer. The ice house was a much-favored, though often illicit, place for children to play during hot weather.

With the advent of air-conditioning, businessmen in the United States discovered that coolness could be used to attract the public. The movie house was often the very first place in a small town to be air-conditioned. Marquees proclaimed it to be "Cool Inside." And often some of the chilled air was intentionally spilled out onto the sidewalk to entice the passers-by to come in. In the hot summer months, advertisements for modern enclosed shopping malls are sure to mention that the entire complex is air-conditioned. It is hoped that people will go there simply to be cool and see other people, in an American version of the paseo--a thermally attracted public which might then be encouraged to buy something.

However, thermal comfort is not just something that draws people together, but also an experience to be shared. It is a simple bodily pleasure, and like other basic human experiences, such as

eating, it is pleasant to share it with people we like. Feeling good together, and being aware of it, creates a certain social bond. It is as simple as: "Yes, we have felt happy and alive together. It is pleasant to be together: we are friends."

Thus, sharing a pleasant thermal experience might be a way to reinforce friendship. In North Indian villages people live with a minimum of furniture, using a simple woven cot, a charpoy, as a portable bed, chair, and table all in one. But there is often one very special piece of furniture, occasionally even embellished with decorative carving or painted designs. It is the swing, an indoor swing wide enough for two or three people to sit together. When friends come to visit the swing is the place to sit for passing the time in easy and intimate socializing. It is the social center, the parlor, of the one-room house.

Sharing the experience of a pleasant thermal setting may also add an extra bonus to courtship. As mentioned previously, the gentle and cooling breeze of the southern porch swing provided a happy excuse for a couple to sit quietly together. A more technological version might be seen in the type of car which the teenagers of the 1950's considered the ideal for a hot date--the convertible. The sheer enjoyment of the cool wind whipping by could set any date in a good mood. Slightly more erotic, perhaps, were the atrium and green houses which were a favorite setting for romance in Victorian England. The lovers could get lost among the leaves of the exotic

tropical plants and possibly mistake the hot humid atmosphere for their own concealed passion.[13]

In many cultures it can be found that a thermal place plays a role as a setting importantly identified with the cohesion of the family, the clan, or some other social group. The special thermal conditions provide a reason for the group to come together. As with Wylie's family in the French village, it may be economic necessity that enforces a thermal focus of family life, in order to conserve the effort and resources that must be expended to create the extra warmth or coolness. Yet, regardless of the incentive, the thermal place provides a particularly appropriate setting to affirm a group's unity, for the individual's enjoyment of the physical comfort reflects on the sense of well-being of the group as a whole.

The hearth is well known to us as the center of family life for European peoples. The Chinese k'ang, the raised earthen platform described earlier, performs a similar function in China and Korea. In Arab villages, the coffee pot, with its small fire underneath, forms the focus of the Mudhif, the social hall, where each evening the village men gather to talk over the day's events.[14] In India, the center of the village is traditionally the great shade tree, where the village council meets and where the children are taught to recite the ancient texts.

In Los Angeles, the hearth was inherited from European culture as the symbolic center of the home, and most every house is bound to

have a vestigial hearth, whether or not a fire can actually burn there. Yet in the hot climate, and affluent economy, of Los Angeles, the swimming pool is more likely to be the real focal point of the house. The pool is the place for the family to relax together, floating in its cool waters, or simply sitting around its edge. The pool deck provides the setting for family barbeques, birthday parties, and cocktail parties. A typical house plan focuses the view from all the social spaces of the house out onto the pool, the family's pride. Even when inside, an expanse of sliding glass doors allows one to feel intimately associated with the pool's glimmering water.

In Japan, the portable kotatsu forms something of a focus for family life. The Japanese have notoriously unheatable houses. They have traditionally preferred to design their houses to be cool and airy in summer, and then to get by in the winter with very local ways to heat the body. Smallest of all means is the kairo, a little case carried around in pockets or between layers of clothes, that contains a warm charcoal ember. The habachi is a small pot of charcoal that is carried around from room to room to warm the hands. The kotatsu is a foot heater, but which can be shared by a number of feet. It has a low table-like frame with a quilt over it that is drawn around one's body to keep the heat in. Noriko, an architect in Japan, described the place of the kotatsu in modern Japanese life: "One can imagine a scene [around the kotatsu] like this; children watching TV and/or doing homework, mother knitting or doing some other things.

Father...may be reading or just lying around. However, today, most of the houses have a gas, oil, or electric heater for each room... and the families seem to gather less in one room which is too bad."[15]

Perhaps more important as a social center for the Japanese are the hot baths which have been called "la grande passion of the Japanese."[16] Ruth Benedict wrote in her study of post-war Japan: "For the poorest rice farmer and the meanest servant, just as for the rich aristocrat, the daily soak in superlatively heated water is part of the routine of every late afternoon."[17] Every village, and every neighborhood in a city, traditionally has its own communal hot baths where the residents come to bathe together every night. To not go to the baths means one is sick or angry or antisocial.[18] It is a social occasion, a time to relax after the day's work and enjoy one another's company.

One washes thoroughly before entering the bath in order not to dirty the water for the others. The extremely hot water and steamy atmosphere make one almost liquid inside, an inner heat which lasts long after the bath is ended. Villagers used to have no compunction about walking home naked from the bath, for what is the use of clothes when one is warm already?[19] The lingering heat from the bath can also provide partial remedy for the coolness of the Japanese houses. Noriko reports that before she bought a modern heater for her apartment "I would go to a bath and then go to bed immediately after that in order to keep the heat."[20]

The importance of the social function of the bath has been described by John Embree, in his study of a southern Japanese village before the war. Although each household had its own bathhouse, with a tub just big enough for one person, the bath was still a community occasion. Women of neighboring houses took turns doing the work to fill the tub and heat the water, while the others came to use it. "The evening bath plays an important role in the household life, especially of the women. After the menfolk have bathed, the women will take their turn. If a woman has...one or two younger children, they all sit in the tub together. This intimate association every evening creates a strong social bond within the family between the mother and her children....Frequently, two or more women will bathe together, one being in the tub at a time, the others standing by and talking. There is a warm intimacy about these evening chats which keeps close the relationship between the women of three or four neighboring houses...."[21] Noriko reports that although many families today have their own private baths, they will still go to the local public bath "because it is larger and nicer." "Public baths are still popular today and I believe it is a great gathering place for the community. I see old ladies taking ages to put on their clothes because they are too busy gossiping. I am sure the lady in charge of the bath in our town knows all the kids in town since the time they were babies."[22]

A similar social ritual is developing in the apartment complexes

and mobile home parks of California around the jacuzzi baths. The jacuzzi provide a place for groups of friends formed within the complex to get together for a casual visit while they relax in the hot swirling water. Beginning in the evening, small groups make their way down to the jacuzzi, knocking on doors to gather friends as they go. Each group has a certain time when they have command of the jacuzzi. One group goes before dinner; another right before bed; one incorporates the hour into the traditional cocktail hour and bring their drinks with them.[23]

The associations of comfort and people and place are reinforced by ritualization of the use of the place. Using the place at a set time and in a specific manner, as the Japanese use their baths, creates a constancy as dependable as the place itself. It establishes, in time and behavior, a definition of the place as strong as any architectural spatial definition, such as the aedicula, might be. Ritualized use can do more than reinforce the affection for a place. Through ritual, the place become an essential element in the customs of a people.

Sacredness

Fireplaces have a more significant position in the American home than a simple analysis of their function would indicate. People love having a fireplace, even if they rarely use it. The ostensible function of the fireplace, to provide a source of heat for the house, has long been taken over by far more efficient central heating systems. When a fire is lit, it is likely to be a ceremonial event: as a way to make the house feel especially "homey"; as a treat when guests come to visit; as a way to give an added air of celebration to a holiday such as Christmas or New Year's. Many modern houses have fireplaces installed with jets of gas that flicker about a permanent concrete log, intended to give the sense of a hearth without the fuss of having to actually build a fire. In such cases it is clear the fireplace is valued more for its symbolic role than its thermal function. The meanings which the fireplace holds are an extremely important element of "what it is". Thus, the hearth is a symbolic center of the home as much as it is a place for burning wood.

There are many other thermal settings, in addition to the fireplace, which have remarkable significance within their cultures. They are apt to have many layers of meaning, from the personal

meanings distilled from each individual's unique set of experiences, to those inherited from the experiences of the culture as a whole. Yi-Fu Tuan, in Topophilia, his study of how and why people develop a "love of place", writes: "A symbol is a repository of meanings. Meanings arise out of the more profound experiences that have accumulated through time."[1] To the extent that a place becomes a repository of meanings that are valued by a culture, then it also acquires value by association. In the same way that one can come to love a book because it contains important ideas, so too one may value an object or place for the ideas that it embodies. In a sense, the place, in its role as a symbol, stores the idea, giving it a physical reality outside of the mind.

In religious societies, sacredness is a way to communicate the extreme importance of a symbol to the society. When a symbol represents something considered essential to human experience, its preservation is of paramount importance. By deeming it sacred, a symbol becomes inviolable, insuring its survival through time.

The sacredness of the domestic hearth is common to many cultures. Our own concept of the primacy of the hearth may include the image of a fire burning brightly in the parlor of a nineteenth century family, or perhaps stretch back a century or two earlier to the huge central fireplaces of early New England houses, used for both heating and cooking. The meanings attached to the hearth however, have accumulated through a much longer history. They are reflected in

traditions which have ancient, perhaps prehistoric, roots.

The hearth developed especially great significance in Europe, where pagan religions formed a foundation of ongoing folk traditions long after the establishment of Christianity. Many of the traditions probably grew out of early fire worship rites. It is clear that fire gods were prominent in the pantheons of the Indo-European peoples. The Aryans of Vedic India worshipped the fire-god Agni. "He was man's domestic friend, the father of the sacrifice, the mediator between men and gods, the bearer of hymns and prayers from every family alter upwards towards heaven."[2] At the other end of the continent, the Irish Celts worshipped Bel, or Baal, to whom they lit great bonfires each May Day, also known as Beltane Eve.[3] Frazer makes the argument that the great fire festivals of Europe were linked to the annual death and resurrection of the sun: "From the standpoint of primitive man nothing might seem more appropriate than to kindle fires on earth at the two moments when the fire and heat of the great luminary in heaven begins to wane or to wax."[4] Indeed, the solstices, and for some tribes, the equinoxes, were occasions for building huge ceremonial fires, such as the great bonfires which were burned on Midsummer's Eve in villages all over Europe up through the nineteenth century (and still continue to be in Scandinavia). Yuletide, which has come to mean the Christmas season, was originally the name for the heathen winter solstice fire festival. The English custom of the Yule log, which is burned for the Christmas Eve fire (often a

charred fragment is saved to kindle the next year's Yule fire), is a remnant of the pagan fire ceremony which has been absorbed into the Christian customs. Frazer explains:

> "Certain it is that the winter solstice, which the ancients erroneously assigned to the twenty-fifth of December, was celebrated in antiquity as the Birthday of the Sun, and that festal lights or fires were kindled on this joyful occasion. Our Christmas festival is nothing but a continuation under a Christian name of this old solar festivity; for the ecclesiastical authorities saw fit, about the end of the third or the beginning of the fourth century, arbitrarily to transfer the nativity of Christ from the sixth of January to the twenty-fifth of December, for the purpose of diverting to the Lord the worship which the heathen had hitherto paid on that day to the sun."[5]

The hearth also was commonly considered the domestic sanctuary of a fire god.[6] It might have housed a major god who was accepted throughout a whole culture, as in the case of the Agni of the Vedic Hindus, or a small local spirit who was responsible only for the protection of the individual house and its residents. In English folklore there is the tradition of the wise cricket who lives in the hearth and brings good luck and protection to the family. The notion of a cricket may have derived from the crackling noises of the fire, but more likely it would seem to have evolved as a diminutive personification of the ancient fire spirit who lived in the hearth. Much of the content of these traditions has long ago been abandoned or forgotten, and yet they have left a sort of emotional residue, or a vague cultural memory, which continues to contribute to the cultural significance of the hearth.

The sauna presents an example rather closely related to the hearth. In Finland, it holds a very important place in national custom. The present day rituals surrounding the sauna are similar to those of the Japanese bath. Although the Finns usually go to the sauna only once a week, instead of the daily visits of the Japanese, the sauna remains importantly the place and the time for the family to relax together.

H. J. Viherjuuri, an historian of the sauna, writes: "Reference to the sauna found in ancient folklore proves that it was generally known long before the beginning of modern times."[7] It is clear that by the Middle Ages the sauna was important both in the routine life and the festivals of the Finns. "They went to the sauna every day to cleanse themselves; there they prepared for great festivals, and there they bathed before wedding ceremonies....Many a child was born in the sauna and many an old man and woman carried there to die."[8]

Viherjuuri explains how the sauna was involved in the religion of the Finns: "The sauna was a place for the worship of the dead, who were supposed to return gladly, even after death, to so pleasant a place....Some people believed that the throwing of water over the stones was a form of sacrificial ceremony. The Finnish word <u>loyly</u>, meaning the 'steam which rises from the stones' originally signified spirit, or even life....'In the sauna one must conduct oneself as one would in a church', according to an old Finnish saying. It was

forbidden to make a noise or to whistle, or to speak indecently in a sauna, because all evil influences had been driven out."[9] While many of the old customs are no longer observed, the sauna continues to be regarded by the Finns with a certain reverence, a reflection of the ancient traditions.

It is interesting that the sauna seems to have evolved from an ancient house form of the Finnish-Estonian people. According to Kalev Ruberg, the log cabin-like sauna developed when the technique for building vertical walls of logs or boards was introduced to the northern forestlands of Europe. (This sauna-house replaced the previous pit-house, a tepee-like structure, which has also been retained in Estonian custom as the summer outdoor kitchen.) As building technology advanced, the Finns and Estonians adopted larger houses, but kept the small sauna-house as an out-building used specifically for hot air baths.[10] It would seem that the early form of shelter became so strongly associated with its thermal function, to provide a warm place in a cold climate, that it was retained for an exclusively thermal use.

The fire of the hearth, and the steam of the sauna, were rather mysterious phenomena for our ancestors, which they explained in terms of their theory of how the world worked: a cosmology comprised of spirits and gods. The fire and steam were valued because they were elemental. They offered an experience of the purity associated with the spiritual realm, and thus, provided a link between the physical

world of human beings and their conception of the principles of the universe. Whether as an earthly manifestation of a domestic hearth spirit or a sun god, the fire was evidence for the powers of the spiritual realm.

We are not now inclined to regard modern heating and cooling systems as representative of a spiritual realm. The physical principles involved in their operation are thoroughly understood. There is no mystery about them. The air-conditioner fitted into the window sash, or the gas furnace in the basement are not thought of as the expressions of a myth, or some metaphysical concept. They are simply functional, designed according to straightforward engineering practice to serve their intended function as efficiently and conveniently as possible.

And yet, functionalism itself can be a kind of religion. It is part of the cosmology of a mechanistic universe, where all objects and physical phenomena behave only according to objective principles. Building systems, machines, appliances, come to be regarded as having a reality independent of human beliefs: their form, their function, determined solely by physical laws. They are all, however, most fundamentally, artifacts. They all have their origins in the human mind, and therefore, are inevitably formed by, and expressions of, the values, attitudes, and prejudices of their makers.

From the 1950's and 60's we have inherited numerous heating and cooling systems created within an ethos of universal convenience.

Machines to maintain our thermal comfort were conceived of as mechanical servants, providing for our every need, while, like an English butler, remaining as unobtrusive as possible. Systems have been devised that can be given instructions by remote control, or set to turn themselves on and off to automatically maintain the perfect thermal conditions. Portable unit heaters and air-conditioners can be plugged in wherever a little extra warmth or coolness is desired. In addition to heating or cooling the air, appliances are available to exhaust stale air; to humidify it, so one's mucus membranes won't dry out; and to filter the air, so it will be free of all odors, dust, and pollen. The ideal seems to be a beneficent robot who will understand and meet all of its master's needs.

A striking contrast to the appliance approach to thermal comfort is seen in the ethos embodied in the design of passive solar-heated buildings. With the development of an ecological consciousness in the United States, has come an attitude that we should not use technology to distance ourselves from the natural world, but rather we should strive for a more intimate, even symbiotic, relationship with natural forces. Solar design, especially in passively solar-heated buildings, provides a prime expression of these values, and thus, has come to be seen as a symbol of them.

Karen Terry's house in Sante Fe is perhaps one of the most compelling passive designs. Stepping down its hillside site in four tiers, it nestles low into the ground. Thick adobe sidewalls create

a strong sense of shelter, while its banks of windows look resolutely to the sun. The image is very much of a house attuned to sun and earth.

Rather than the convenience of a constant indoor temperature regulated by a thermostat, a passively solar-heated house may go through an air temperature flux as great as 20°F per day. People learn to live with this flux by putting on a sweater or moving to part of the house with the most desirable conditions. Karen Terry follows the temperature changes in her house with a migration strategy similar to the Tunisians, described earlier, who move through their courtyard houses according to daily and seasonal temperature cycles. She works in the cool lower level, where she has her studio, eats in the middle level, and sleeps and bathes in the warmest upper level. She feels that the house, with its openness to the sky and its responsiveness to the climate, helps connect her to natural rhythms. "Living in a solar house is a whole new awareness, another dimension. I have the comfort of a house with the serenity of being outdoors--protected, yet tuned in."[11]

Janius Eddy, who lives in a solar home in Rhode Island, shares Karen Terry's sentiments. He describes the meaning which his house has come to hold for him: "It is not just the financial savings. We grow more in awe of the tenuous hold our lives have on this small planet, more convinced that the sun renews us, in an almost religious way. It has made us profoundly grateful that the sun is up there,

the center of our universe, warming us up and keeping us alive. That atavistic sense of the elements that early man knew and felt has become part of our lives."[12] A solar house, responding both to the cycles of the sun, and to the people living in it, is seen to exemplify the human relationship to the natural world.

Such an attitude is quite reminiscent of the ancients' fire worship as a celebration of the death and re-birth of the sun. It suggests a parallel between the symbolism of the hearth and of solar buildings. They both domesticate an elemental force to provide for pragmatic thermal needs. They both bring a primal phenomenon into the realm of everyday experience.

In addition to being invested with meaning itself, a thermal system may also be an element which reinforces the significance, or enhances the meaning of other symbols within a society. A simple example is the air-conditioner in the boss's office. Along with the black leather chair and the deep pile rug, the air-conditioned office is a mark of executive prestige. Interestingly, special thermal qualities are associated with symbolic places in many societies. Perhaps the provision of thermal comfort, and delight, is a way to emphasize the importance of the place for people.

The association of thermal comfort with status, as in the boss's office, seems to be a rather common pattern. The more expensive and difficult it is to provide thermal comfort, the more its use is likely to be restricted only to those purposes deemed most important. Thus,

in Saudi Arabia, when a family can only afford to air-condition one room, it is most likely to be the men's visiting room, the ka'ah, even though the ka'ah is the least frequently used room in the house. Hospitality is an essential value of Saudi society, and so guests are given the best the family has to offer--including the only air-conditioned room.[13]

A mechanically cooled place, especially, is apt to be linked with symbols of status, perhaps because for so long excessively hot weather was considered inescapable. It was the great equalizer; something which everyone had to endure, rich or poor, lowly or royal. While cold weather might be comparatively simple to remedy by building a fire or putting on an extra robe, the technology for actively countering hot weather was extremely complex and expensive. In mideival Islamic countries, incredible effort was expended to cool the throne or pleasure pavilion of the sultan. Elaborate water works were used to cool an area by evaporation. A prince in Alwar in India had his throne room in a marble pavilion which was "completely enclosed in a veil of spray falling from the cornice."[14] A similar approach was employed for the delectation of the Spanish sultan in Toledo: "In the center of the lake rose a water pavilion of stained glass adorned with gold. Here the sultan could recline in comfort on the hottest day, encircled by the glistening shower falling from the dome. At night tapers were lighted to glow through the transparent walls."[15] Regardless of how much benefit he actually derived

from the elaborate system of cooling, it certainly added to the aura of power and privilege around the throne of the sultan.

The public baths of ancient Rome are an example of a thermal place that became expressive of the political values in a society. In early Rome, baths were a luxury to be found only in the houses of the very rich; those who could afford to finance bringing in water from long distances and the cost of the fuel to heat it. Entrepreneurs devised the idea of building baths which could be opened to the public for a small fee. Such public baths, or thermae, became quite popular, for as with the Japanese bath, they were both a social gathering place and an important source of warmth. Historians never fail to comment on the great thermal discomfort of the standard Roman apartment house, stuffy in the summer and unheatable in the winter.[16]

The Emperor Agrippa, who as a young man had been a magistrate in charge of the public baths, conceived of the idea of letting the public into the baths free. It was a grand egalitarian gesture, certain to make the government popular with the people. Carcopino describes it as "A revolutionary principle in keeping with the paternal role which the empire had assumed toward the masses."[17] Agrippa founded a bath to be free in perpetuity, named after himself, of course. Later emperors continued the tradition, each vieing to construct the most enormous and sumptuous bath of all.

These thermae were among the principal wonders of Rome. No

expense was spared in their construction and decoration. The finest marble, collections of fine sculpture, and elaborate mosaic work combined to make the baths incredibly opulant. "The fabulous decoration lavished on the baths made the exercise and care of the body a pleasure for all, a refreshment accessible even to the very poor."[18]

The thermae were huge buildings, with great domed spaces for the baths and many ancillary spaces for the other public uses incorporated into the complex. Carcopino provides a description of the baths:

> "Near the entrance were the dressing-rooms where the bathers came to undress. Next came the tepidarium, a large vaulted hall that was only gently warmed, which intervened between the frigidarium on the north and the caldarium on the south. The frigidarium, which was probably too big to be completely roofed in, contained the pool into which the bathers plunged. The caldarium was a rotunda lit by the sun at noon and in the afternoon, and heated by vapor circulating...beneath the pavement....To the south of the caldarium lay the sudatoria, whose high temperature induced a perspiration like the hot room of a Turkish bath. Finally the whole gigantic layout was flanked by panestrae, themselves backing on recreation rooms, where the naked bathers could indulge in their favorite forms of exercise."[19]

> "Externally the enormous quadrilateral was flanked by porticos full of shops and crowded with shopkeepers and their customers; inside it enclosed gardens and promenades, stadia and rest rooms, gymnasiums and rooms for massage, even libraries and museums. The baths in fact offered the Romans a microcosm of many of the things that make life attractive."[20]

The baths were a physical manifestation of the ideal that every Roman citizen was entitled to benefit from some of the wealth reaped

from the empire. Carcopino writes: "In their dazzling marble grandeur the thermae were not only the splendid 'Palace of Roman Water,' but above all the palace of the Roman people, such as our democracies dream of today."[21]

Temples in India offer an intriguing example of the conjunction of a thermal place with a sacred place. The great stone temples of South India, such as those at Madurai and Kancheepurum and many smaller temple towns, provide a sanctuary from the pervasive heat of the tropic climate, where the seasons are sometimes described as hot, hotter, and hottest. A visit to one of these temples will quickly convince the traveler that they are the coolest place to be found in South India, except, of course, the air-conditioned international tourist hotels. Townspeople and pilgrims come to the temples for prayer and meditation, but often stay to take their afternoon siesta on the cool of the stone floors, and even to conduct business along the deeply shaded arcades. While the rest of a traditional Hindu town is built of mud and thatch and wood, the use of stone is reserved for temples. It is used for the pyramidal structures which top the shrines (vimana) and gateways (gopurum) and for the columned halls and long arcades which enclose the sacred compounds. This enormous quantity of stone provides a thermal mass which never reaches the extremes of the air temperatures.

A cool town center, for both sacred and social uses, can be found in the traditions of the ancient Aryans. The villages of the

Aryan tribes were centered around a huge tree that "symbolized the axis around which the universe and the celestial realms were believed to rotate."[22] It was in the cool shade of this sacred tree that the village elders met in the panchayat, or village council, and it was there that the children were instructed in the sacred texts. This shaded village center grew to include other communal and sacred functions, such as a community dancing ground, a local shrine, and importantly, a well or open water tank.[23]

The tradition of the great shade tree as the sacred meeting place at the center of the village may have served as an analogue for the great stone temples which began to be constructed in the medieval period. Newly powerful Hindu rulers sponsored the building of the temples to form the nuclei of towns. (Until the medieval period, Hindus had worshiped primarily at small local shrines and individual altars.) The temple compounds included not only the sacred shrine, but the other more communal functions of the traditional Aryan village as well. There was a dancing hall, a temple tank for ritual ablutions, and a deeply shaded place for the discussion and teaching of religious texts.

The stoneworking technology necessary for building the temples were late to develop in India. The earliest stone temples were not constructed; they were carved. The chaitya-halls, or prayer halls, of the Buddhists (c.250-700 AD) were hewn directly into the face of rock cliffs. At Ajanta, thirty such temple-caves can be found along

a single cliff wall. Monasteries were also carved out, using the model of a single-storied wood house built around an atrium, with rooms that open directly onto the court.[24]

The association of caves with religious pursuits is quite common, as Bernard Rudofsky charmingly points out: "Faith, piousness, and religiosity of all shading seem to thrive in their padded silence....The basic cavern...with its dripping water and bone chilling drafts...is supremely qualified to induce a feeling of lightheadedness which furthers meditation."[25] Caves are the stereotypical home of the Christian hermit along with the Buddhist and Hindu ascetics of India. Innumerable churches were carved into the ground in Ethiopia, in Anatolia, Southern Italy, and many other areas around the Mediterranean. However, the distribution of such cave retreats has a clear climatic component: they are found only in warm climates where the nearly constant temperature of a cave is cool and comfortable, rather than cold and uncomfortable as is a northern cave.

The Buddish chaitya-halls served as an important prototype for the first South Indian attempts at stone temples. One early Hindu ruler is reported to have initiated a competition among architects to determine the best form for Hindu temples to be built with the new technology of stone work. Buddhist chaitya-halls and monasteries, in addition to portable wooden shrines and reed-roofed houses, were used as models for the reduced-scale temples that were carved from a single ridge of stone--the competition site. These diminutive

temples were left half-finished, some columns carved to full detail and others left only roughly formed.[26] The most successful model proved to be a square pyramid, a form which satisfied all the formal, ritual, and cosmological requirements for Hindu worship.[27] It also effectively placed the sanctuary under a mountain of stone. The earliest temples, such as the shore temple at Mahabilipurum, consisted of this pyramid over the shrine, the vimana, surrounded by a low wall. Additional compounds were commonly added later in concentric rings, forming a rectangular mandala, each inner ring being progressively more sacred. With each ring, a larger temple gate, or gopura, was added. The outermost gopurum are enormous and can be seen for miles across the plains.

The temple also included, in its physical form, the means for being blessed by the four elements--earth, wind, water, and fire. Before entering the temple gates, one removed one's shoes to touch, and be blessed by the earth. Then, upon passing through the temple gateway one is blessed by the air with a gust of wind. Villagers believe that the ancients knew how to use the magic of the winds in order to insure that there would always be this breeze blowing through the gateway. In a sense, they did. The high pyramids over the gateways catch the slightest breeze aloft and create a high pressure area which forces a turbulent breeze through the narrow passage at ground level, in the same way that American skyscrapers create gusty wind problems at their base.

A blessing by water is obtained by bathing in the temple tank, or at least descending its steps to touch the water and get a piece of one's garment wet. Finally, on entering the cool interior of the sanctuary, an attendant priest makes a mark on the worshipper's forehead with ashes taken from a small, sacred flame. Even this blessing by fire has a slight cooling sensation to it. Perhaps it is only coincidental that each of these four blessings is associated with a cooling sensation; and yet the use of forms and material which inevitably create coolness is quite remarkable.

Some mention should be made here of the role of the temple tanks. Their use is quite ancient, as evidenced by the excavation of tanks at Mohenjo-daro (c.2000 BC). It is presumed that, in addition to serving as a water reserve for the community, they were also used for ritual bathing, a purification rite common in India and many other cultures.[28] Similar tanks are found in today's India, both within the temple grounds, and along the roadside, often with a large banyan or other tree shading the water and the steps leading down to it, where they provide a cool wayside stopping place for the traveler. Some of the tanks or wells outside of the temple compounds have a sacred nature of their own. The step-well temple at Adjalaj in the north Indian desert is an interesting example. The temple-well is built as a series of columned terraces which step six stories into the ground to meet the variable level of the water table. The well serves as a gathering place for villagers who seek relief from the

desert heat. They come to get water and also to worship. Ablutions are performed at each level of the step-well, as they descend to the progressively darker and cooler levels, gradually approaching the water at the bottom.[29]

From these examples, Islamic thrones, Roman thermae, Indian stone temples, we can see places whose thermal qualities reinforce the significance of the place within the culture. The thermal qualities may be operating on a level of necessity, as with the Roman baths or Indian temples, using collective resources to make basic warmth or coolness available to the whole community. They may employ elements of delight, as in the pleasure pavilions of the sultans or the sensual blessings from the four elements of the Indian temples. And they may enhance the attractiveness of the place as a social setting, such that like the Roman baths and Indian temples, it becomes the social center of the community. In all these ways, the thermal qualities enrich one's experience of the place, thus increasing its value. Perhaps the simple bodily experience of thermal conditions is sensed as a metaphor of the more abstract meanings represented by the place: the comfort, the delight, the social affinity, considered manifestations of the overall significance of the place in people's lives.

The integration of all of these aspects of a thermal place is perhaps most powerfully seen in the tradition of paradise gardens in Islamic countries. Here, the garden or courtyard, with a very simple

thermal function--to provide cooling with shade and breezes, and evaporation from water and vegetation--evolved into a complete metaphorical representation of a people's world view. There are two basic types of the Islamic garden. One is the garden in the inner courtyard of a house, such as the famous gardens at the Alhambra in Granada, Spain. The Persian word bustan is used to describe these enclosed, formal gardens, which constitute a basic formal element of Islamic houses from Spain to India. The second type is not nearly so pervasive, but has had an enormous influence on the role of the garden in Islamic culture. It is the palace garden, or rather the bagh, an entity comprising palace and garden together.[30]

Both the courtyard and the royal garden have very long histories in the middle east. Their forms are to be found in the ruins of some of the earliest urban settlements. We know that specially irrigated royal pleasure gardens existed at least as early as the sixth century BC when Cyrus the Great built his palace at Pasargadae in Iraq. Long porticos and a columned pavilon provided shade within the garden compound. A stone water course, with shallow pools at regular intervals "was clearly the installation of a formal garden."[31]

It is quite understandable that for a desert people the garden became a metaphor for paradise. The Bible mentions the Garden of Eden as the paradise which existed on Earth as the original home of humankind before the fall of grace. The Koran continued the tradition of Eden, assuming that it would also be our final home in

Heaven. "Theirs shall be the gardens of Eden, underneath which rivers flow: therein they shall be adorned with bracelets of gold, and they shall be robed in green garments of silk and brocade, therein reclining upon couches--O how excellent a reward! And O, how fair a resting place!"[32]

To provide an image of its promised paradise, the Koran used descriptions of earthly pleasures such as might have been found in the royal pleasure gardens of the time. There shall be "two gardens, green green pastures, therein two fountains of gushing water, therein fruits, and palm-trees, and pomegranates, therein maidens good and comely,...houris, cloistered in cool pavilions..."[33] And: "Therein they shall recline upon couches, therein they shall see neither sun nor bitter cold, near them shall be its shades, and its clusters hang meekly down..."[34] In these passages it can be seen that the coolness of shade and water and lush greenery is one of the most essential attributes of this garden paradise. It sounds indeed like the paradise of a desert people.

The Koranic description of paradise became a guide that earthly gardens were patterned after. With their gardens, the faithful hoped to create an anticipation of heaven, and immodest rulers tried to build themselves a paradise on earth. "Islamic legend preserves the story of Shaddad, an ancient king of South Arabia, who attempted to rival Paradise by building the Garden of Iram in his kingdom. The story relates that a messenger was sent by God to Shaddad, warning

him not to challenge the Almighty. When Shaddad ignored the warning, God destroyed the garden."[35]

The Koranic descriptions were carefully studied to determine the proper geography of Paradise, so that gardens could be laid out with the same forms. In one Koranic verse, two gardens are mentioned, with two fountains of running water, which suggested that paradise was made of two-times-two gardens. A fourfold division of paradise was also suggested by the four rivers mentioned in the book of Genesis that flowed out from Eden. The cruciform division of the garden, by four channels of water that meet in the center, became traditional throughout Islam. This form was especially reinforced by contact with Persian cosmology, as James Dickie explains:

> "In Persian ceramics approximately datable to 4000 BC, the world--represented by a plaque or bowl--appears symmetrically divided into four zones by two axes forming a cross; at the point of intersection a pool is depicted: in other words, there are the focal point of the world the Spring of Life breaks the surface. This iconography, closely connected with the mandala of Buddhist iconography, expresses a vision of the universe, a life-symbol, which, by virtue of its adoption by conquering Arabs, was distributed throughout the entire extent of their empire. In this manner the Iranian garden came to constitute the prototype of the Islamic garden."[36]

While the parallel between celestial paradise and earthly gardens has ancient origins, it was the poets and religious teachers of Medieval Islam who most elaborated the metaphor. The Sufis, in particular, were fond of pursuing analogies between nature and the devine. The most benevolent aspects of the weather, the cool breezes

and the rain, were identified with either God or the Prophet. The cool breeze was seen as the Breath of God bringing his message of love, as words are carried on the breath of the speaker: "For mystical poets like Rumi, the appearance of the leaves in the spring is caused by their listening to the devine call Alast....Moved by this word as manifested in the spring breeze, herbs and flowers come into existence in an enraptured dance."[37] Rain is the symbol of Divine Mercy, and is even commonly referred to as "mercy" by villagers and peasants. "The life-bestowing activity of the rain is connected with that of the Prophet of Islam who was sent 'as a mercy for the worlds'; hence we can understand the numerous poems which symbolize Muhammed as the 'jewel-showering cloud,' or as the rain cloud 'pregnant from the ocean of love' which slowly wanders from Mecca to Istanbul and Delhi to quicken the dead gardens of the human hearts by his message."[38]

The Sufis especially delighted in using the state of the garden as a metaphor for human behavior. The soil of the garden was identified with the mortal human being: "As the dead earth will be resurrected in spring to be adorned with lovely green sprouts and flowers, the dead bones of the true believers will be quickened again as they are allowed to enter paradise."[39]

This link between the lives of the owner and garden often continued literally after death. While the word firdaus stands for both garden and paradise, another word rauda can be used

interchangeably for garden and mausoleum.[40] In India there are many grand pavilions which now sit in the midst of a barren piece of ground, empty monuments whose only function is to shelter a sarcophagus. Elaborately carved stone screen-work, patterned marble floors, airy vaults combine to make them wonderfully cool places. It seems a bit strange that so much effort was expended to provide thermal comfort for a sarcophagus. But once, each was the pleasure pavilion for a king's garden. The Mughuls of India developed the tradition of each ruler commissioning his own garden. Then, "At the owner's death the pavilion, generally placed in the center of the site, became the mausoleum, and the whole complex passed into the care of holy men."[41] Thus, rather than passed from one generation to the next, the garden was specifically for the one king. James Dickie writes: "...The garden frequently served as a burial-place where the owner, inadequately satisfied the pleasures it had given him whilst he lived, wanted to continue enjoying them even in death and where--symbolically--he had already entered into Paradise."[42]

The widespread religious imagery of the garden encouraged all gardens, royal or common, to be regarded with reverence, as a continuing allegory of the owner's relationship to God: as the garden prospered, so did the soul of the inhabitant. In the Sufi metaphor, the body of the owner is seen as the earth of the garden, the place itself. Similarly, the life processes of the owner were reflected in all of the processes of the garden, not only the plants that grew

and died every year, but also the water running in channel and fountain, the breezes cooled by shade and evaporation, the sounds and smells of birds and flowers. The life of the garden and the life of the owner were tied together, one as the allegory for the other.

The garden, either as bagh or bustan, is as cental to the concept of an Islamic home as the hearth is central to the European home. It is interesting, then, that the hearth-fire, in old traditions, has a similar association with the life of the inhabitants of the house. Commonly the fire of the hearth was not allowed to go out. It was carefully covered with ashes each night at curfew (couvre-feu) such that a few selected embers would survive until morning. Raglan comments that "the alarm and horror felt if the hearth-fire went out are out of all proportion to the inconvenience caused" by the need to relight it.[43] The fire was ritually extinguished and rekindled only on special occasions, usually having to do with the death or, less commonly, the birth of a member of the household.[44] The Catholic Church absorbed this tradition into Easter ceremonies, marking the death and rebirth of Christ: "On Easter Eve, it has been customary in Catholic countries to extinguish all the lights in the churches, and then to make a new fire....At this fire is lit the great Paschal or Easter candle, which is then used to rekindle all the extinguished lights in the church."[45] The symbol of the eternal flame, which we use for our Olympic games or on the grave of a president, would seem to have had a long history as

the continuing hearth fire which represents the life and welfare of the residents of the house.

The connection between the life of the fire and the life of the inhabitant is also seen in the custom of the housewarming ceremony. In contemporary America, a housewarming party is given when a family moves into a new house. Perhaps it is all of the friends and their good wishes that are thought to metaphorically warm the house. But in traditional cultures the warming is quite literal, for it involves the bringing in, or the first kindling, of the hearth-fire which then gives the proper spirit and sanctity to transform the physical structure of the house into a home:

> "In ancient Greece the hearth or hestia was the centre of domestic life. At a wedding, fire was carried to the hestia in the new home by the bride's mother, thus ensuring the continuity of domestic worship. In India the newly wedded pair formerly brought to their own house a portion of the sacred fire which had witnessed their union and which, when kindled on their own family hearth, had to be maintained ever afterwards for use in all domestic ceremonies, including the last ceremony of all, the final burning of their bodies after death ....In Wales even now cases are known, when a new household is being started, of carrying fire from the parent hearth."[46]

Regardless of the religious rationale used by the people, we can easily imagine from our own experience why the fire might be used as a symbol of the life of the house and the family that lived there. The fire was certainly the most life-like element of the house: it consumed food and left behind waste. It could grow and move seemingly with its own will, and it could exhaust itself and

die. And importantly, it was warm, one of the most fundamental qualities that we associate with our own lives. When the fire died, its remains became cold, just as the body becomes cold when a person dies. Drawing a parallel to the concept of the soul which animates the physical body of the person, the fire, then, could be seen as the animating spirit for the body of the house.

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