Built-Light:
Analysis and Generation of Associative Natural Light Environments

by

Henry Sheppard Plummer

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Signature of Author.....Department of Architecture
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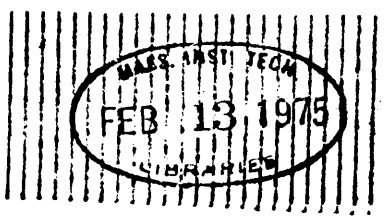
Certified by.....Maurice K. Smith
Professor of Architecture

Thesis Supervisor

Accepted by.....Chairman, Graduate Studies Committee
Department of Architecture



Built-Light: Analysis and Generation of Associative Natural Light Environments

Henry S. Plummer

Submitted to the Department of Architecture in January 1975 in partial fulfillment of the requirements for the degree of Master of Architecture.

An exploration of the language of environmental light; both its associative meanings and built generation. The intention is to map out a constructive framework for the humane use of natural light in buildings and in the public urban environment; to examine the human dimensions of light as it exists and how it could exist. The associational bases for making built-light decisions are explored along with their historical precedents, within some rather distinct families of light experience. These are accompanied by visual illustrations of some design applications. These associational bases form the framework for an architectural reorientation to natural lighting and for building reciprocally with the sun.

Thesis Supervisors: Maurice K. Smith
Professor of Architecture

Gyorgy Kepes
Professor of Visual Design

Jonathan Green
Associate Professor of Photography

The nature of the 'material' or 'medium' explored in this Thesis required that most of the visual work be recorded on color transparencies. The costs of their duplication unfortunately prohibited the inclusion of this material in the library copies; however, a relatively complete copy of this work is available in the files of Professor Maurice Smith, Department of Architecture, Room 7-301.

The material excluded here, includes:

1. color slides which illustrate the environmental light qualities discussed in the text; examples from nature, city, building, painting, photography.
2. color slides of two design projects, briefly described at the end of the text, in which sequential light environments were generated in surrogate form with stainless steel, glass, water, ice, and animated by the movements of the sun and wind.
3. color slides of sepia prints which document the physical modulations of the two design projects; these were very dark sepia prints to which color pencil had been added to simulate the light qualities present.

And after ten years spent in the heart of it, rejoicing and wondering, bathing in its glorious floods of light, seeing the sunbursts of morning among the icy peaks, the noon day radiance on the trees and rocks and snow, the flush of alpenglow, and a thousand dashing waterfalls with their marvellous abundance of irised spray, it still seems to me above all others the Range of Light.

John Muir

Preface

At first they saw without seeing, listened without hearing and like figures in a dream they lived out their lives in disorder and confusion. They did not know the sunny brick houses, they lived under the earth like the busy ants in the depths of grottoes shut away from the sun.

Aeschylus

One of the great environmental losses encountered in the modern world is the absence of associative natural light qualities within the built environment. The natural pageantry of sunrise and sunset, of snowstorm and icestorm, of rainbow and water reflection, remain accessible in the outdoors, but their celebration as either ritual or built equivalent has ceased within the modern urban world. Temple and observatory, pageant and festival, built celebratory constructions of the most intense love and reverence for the light of the sun, and rituals of solar interaction, dependence, renewal, and continuity, are no longer available to modern man. The rich potential of

sunlight to nourish him, in ways ranging from luminance for sight to temporal calibration through the days and seasons, from the gift of life-giving heat to the evocation by highly intrinsic light qualities of the most intense meditative or euphoric feeling-states within us, has all but been eliminated from modern architectural vocabularies, and in most cases, severely abused. Rather than finding oneself in a built-light world of food, it is more often that of poison: of enormous buildings with artificially lit sun-starved interiors, choked off from both natural light and natural time, of buildings constructed in defiance of solar gifts and consequences, producing uninhabitable interiors saved only by enormous inputs of other precious energy sources, and of interior intrinsic light qualities which drain, rather than replenish or enrich us.

If the generation of associable light places is going to provide festive and nourishing moments within the environmentally impoverished daily experiences of many people, they must be able to occur both as interjected zones of life within existing places, as well as a field of built definitions within new constructions. This

suggests two rather different, but complementary, qualities of light-place which need to be generated, differing in their intensity of energy: one highly intense and rich for occasional peak conditions of light, the other of much lower intensity for entire regions of new building.

The destructive and hostile physical environment we find ourselves in within most of the industrialized world, can in some places be locally transformed with highly intense interventions which provide brief, but significant, relief and nourishment within a more hopeless context. These new places could function much as do the water fountains of Rome during the intensely hot Italian summer. Passing by, or within, a field of these oases, evokes a significant emotional and physical uplift. Analogous urban light-fountains could provide a somewhat similar kind of rejuvenation, but with an entirely different medium. These could be generated in outdoor public regions as well as in dark internal zones, and in new construction might be included in at least some small portion of the building. Such light-fountains would be both celebratory and therapeutic, places of highly intrinsic light association within a less intense, and in most cases depressive,

context. These qualitative light-intensive regions can provide large numbers of people with life-reinforcing interactions with sunlight, which were accessible to people in previous eras in the cathedral, basilica, observatory, temple, and palace.

Very rich, high energy light qualities are, however, expensive, and in many cases inappropriate settings for activities requiring large amounts of clear, relatively diffused light. For the majority of use-regions, then, we need an additional qualitative light vocabulary which can provide the generation of an equally life-supportive but low-energy, field of natural light. This would provide a relatively low-cost habitable light-framework, within which a highly intrinsic light zone might occasionally occur. These definitions would not contain dramatic or highly colored crescendos of light, but instead the less obtrusive qualitites which are more comprehensively supportive. Much indigenous architecture can serve as a reference for such low-energy light frameworks, containing multiple associative considerations and articulations of natural light as illuminator, heat source, carrier of temporal and visual information, and material for intrinsic

low-intensity light qualities.

We will now try to explore the content of this natural light vocabulary, both its basis in our elusive but profound associations with sunlight, and the built processes and capabilities necessary to generate it. If we can begin to understand the enormous powers of sunlight to affect the habitable qualities of our physical environment, we can then begin to articulate its potential for rejuvenation, healing, and transcendence as social values and needed qualities of life.

The intention is to explore and map out a constructive framework for the humane use of natural light in buildings and in the public urban environment; to examine the human dimensions of environmental light as it exists and how it could ixist.

The associational bases for making built-light decisions are explored along with their historical precedents, within some rather distinct families of light experience. These are accompanied by visual illustrations of some design

applications. These associational bases form the framework for an architectural reorientation to natural lighting and for building reciprocally with the sun. They draw heavily on the accumulated wisdom and modulation skills of the past; to avoid 'reinventing the wheel' at this time of contemporary environmental crisis. Rather, the intention is to reestablish a continuity with previous understandings of the potential of environmental natural light to nourish and enrich the quality of our lives; to reassert, through places and modulations of light, our temporarily 'lost' connections to the earth and cosmos, our sense of ancestry and kinship with the rest of earthly life, and with those who preceeded us in our long evolution on this planet.

1. Illumination

The words by which Io fashioned the universe-that is to say, by which it was implanted and caused to produce a world of light-the same words are used in the ritual for implanting a child in a barren womb. The words by which Io caused light to shine in the darkness are used in the rituals for cheering a gloomy and despondent heart, the feeble aged, the decrepit; for shedding light into secret places and matters, for inspiration in song-composing and in many other affairs, affecting man to despair in times of adverse war. For all such ritual includes the words (used by Io) to overcome and dispel darkness.

Hare Hongi (a Polynesian of today)

Probably more free sunshine falls on this majestic range than any other in the world I've ever seen or heard of. It has the brightest weather, brightest glacier-polished rocks, the greatest abundance of irised spray from its glorious waterfalls, the brightest forests of silver firs and silver pines, more starshine, moonshine, and perhaps more crystalshine than any other mountain chain, and its countless mirror lakes, having more light poured into them, glow and spangle the most. And how glorious the shining after the short summer showers and after frosty nights when the morning sunbeams are pouring through the crystals on the grass and pine needles, and how ineffably spiritually fine is the morning-glow on the mountain-tops and the alpenglow of evening. Well may the Sierra be named, not the Snowy Range, but the Range of Light.

John Muir: "My First Summer in the Sierra" (August 26)

All at once...my eyes were opened. Above and in front, yet in me, of me, and around, was the Glory of the Archetypal Light. Nothing can be more truly light, since that Light makes all other light to be light; nor is it a flat material light, but a creative light of life itself, streaming forth in love and understanding, and forming all other lives out of its substance.

J. H. M. Whiteman

There was an impression of drawing strength from a limitless sea of power and a sense of deepening peace. The light grew brighter, but was never dazzling or alarming. I came to a point where time and motion ceased...I am absorbed in the Light of the universe, in reality flowing like fire with the knowledge of itself, without ceasing to be one and myself, merged like a drop of quicksilver in the whole, yet still separate like a grain of sand in the desert.

Warner Allen

The great associational potency of varied intensities of environmental luminance, lies in their power, as habitable pools of almost physical substance, to envelop and seemingly saturate one's entire insides with their respective associational qualities, in a process almost independent of control or manipulation. The most one can do to affect this direct flow of visible energy, is to become either more or less conscious of it, to open oneself up to a greater degree, to feast on it, or conversely to restrict its process to the unconscious. This phenomenon is probably best illustrated on sparkling, sunny days, in both the outdoor landscape and within bright open interiors, where both receptive and closed individuals alike, seemingly

inhale and ingest undepletable portions of this mantle of radiant energy, lifting themselves from states of relative inertness and catalyzing a celebratory state in their private and public interactions with the outside world. The weekend drive to the beach, basking in the sun on hot summer afternoons, the sunday promenade at Rome's Villa Doria Pamphili, all provide means to satisfy this universal desire.

What is associatively important about this process of soaking up light energy, is the inherent capacity of different levels of spatial luminance to catalyze varied degrees of transcendence. It would seem that there is a somewhat direct relationship between the amount of natural light one is immersed in and the resultant uplifting of energy and emotions, up to rather particular sensory limits beyond which light becomes both uncomfortable and destructive. At one extreme of natural illumination is the blinding light of the desert, in which there is such an outpouring and reflection of aggressive light, that it blots out the surrounding world. This luminous condition has moved past an associative threshold which seems to peak on sunny days within less totally reflective

environments. At the other end of the scale is the condition of no-light, of the blackness of night and dark interiors, where there is such little presence of light energy that it becomes a region of visual rest and relief. Illumination levels range from these inactive, recessive qualities, up through increasingly exhilarating conditions of accelerated life and energy, and ultimately to those over-intensive conditions which surpass and overload our sensory equipment.

The process by which this transcendence occurs is not at all clear, though a clue may come from our knowledge that as a molecule absorbs a quantum of light, it becomes excited in a manner that can be transmitted as a resonance, reradiated as fluorescence, or transformed into heat. It may be that, in an analogical way, the intake of light quanta is internally transmitted to nourish and heal some part of us, reradiated back out to the outside world through our more energy-porous extremities, particularly the eyes, hands, and face, and additionally transformed into heat to provide us with warmth. If so, it would not be accidental that all three of these processes increase on sunlight-plentiful days, and can be easily felt within

ourselves, as well as clearly observed in others.

These phenomena have probably found their most intense and celebrated articulation in connection with occurances of private transcendence, of spiritual illumination. Commonly described experiences include feelings of exaltation, immense joy and harmony, shining and radiation (particularly from the eyes and face), and a rise in the temperature of the body.

> If the effulgence of a thousand suns were to shine at once in the sky, that might resemble the splendour of that great being.
> I see Thee with diadems, maces, discus, shiningly effulgent everywhere, blazing all around like the burning fire and the sun, dazzling to the sight and immeasurable. I see Thee without beginning, middle, or end, with infinite power, with numberless arms, the sun and moon as Thine eyes, Thy mouth as the blazing fire, heating this universe with Thine own radiance. 1
>
> The Bhagavadgita

> I can't look at you Father, your eyes flash lightnings, your face is more dazzling than the sun, and it hurts my eyes to look at you...I looked and was seized with pious fear. Imagine the face of a man speaking to you from the middle of the sun, from the brightness of its dazzling midday beams. You see his lips moving, the changing expression in his eyes, you hear his voice, you feel his hands holding you by the shoulders, but you do not see those hands or the body of the man who is speaking to you, nothing but the shining light that spreads for many yards around him, revealing with its beams the snow-

covered field outside and the white flakes that steadily go on falling.[2]

disciple of St. Seraphim

A light like that of dawn began to shine from above...it gradually grew, making the air brighter and brighter, and he felt as if he and his whole body had quitted the things of this world. As this light continued to shine with ever increasing brightness and became like a midday sun shining in splendour above him, he saw that he was himself at the center of the light and that the sweetness invading his whole body from so near filled him with joy and tears. He saw the light unbelievably uniting with his flesh and gradually pervading his limbs. He saw this light finally invading his body, his heart and his bowels, the whole light invading his whole body and turning him completely to fire and light...[3]

Nicetas Stethatos

This equation of light with divinity is a common phenomenon throughout the religions of the world. God himself is called Light in the Christian scriptures, and emanations of light are considered the visible form of divinity and a power by which God may communicate and reveal himself.

> If one is 'illumined' by baptism; if the Holy Ghost is visualized as a manifestation of fire; if the Light of the Transfiguration perceived by the Apostles on Mount Tabor represents the visible form of Christ's divinity, then the perfect Christian mystical life should logically reveal itself by luminous phenomena.[4]

Thus a monk shines like a flaming fire, particularly at prayer; Jerusalem was thought to be the city of light; at Christ's baptism, fire arose on the Jordan; when Moses came down from Mount Sinai, his face shone; and Adam was created as an effulgent man, but lost his radiance with his sin.[5]

Since light has been thought to be the most direct manifestation of God among all created things, a thing's objective value was a function of the degree to which it contained light.

> For the twelfth and thirteenth centuries light was the source and essence of all visual beauty. The stars, gold, and precious stones are called beautiful because of this quality...This aesthetic preference is vividly reflected in the decorative arts of the time with their obvious delight in glittering objects, shiny materials, and polished surfaces...The development of the stained-glass window, impelled by the astonishing idea of replacing opaque walls by transparent ones, reflects the same taste. And in the great sanctuaries of the twelfth and thirteenth centuries luminousity is a feature demanded and singled out for praise by contemporaries...[6]

Gold was a divine material in ancient Egypt as well, and it is thought that in some Greek temples immense gold statues of the deity faced the rising sun. At Stonehenge, there is an 'unaccountable' unique stone, different in material from

all the other sarsen or bluestones, which contains such quantities of mica flakes that it glitters whereever freshly exposed. This stone may very likely have received the first celebratory rays of sunrise, as related reflective forms seem to have done in other ages and religions. In the initiation ceremonies of Australian medicine-men, the aspirant is sprinkled with liquefied quartz, symbols of supernatural rock crystals.

> Thanks to the rock crystals contained in his body, and particularly in his head, the medicine-man enjoys a different mode of existance from the rest of mortals. Quartz owes its extraordinary prestige to its celestial origin. Baiamee's throne is made of crystal, and Baiame himself drops on to the earth fragments broken from his throne. In other words, the crystals are supposed to have fallen from the vault of heaven; they are in a sense "solidified light." Indeed, the Sea Dayaks call these crystals "light-stones"...[7]

With or without the religious implications of transcendence, the power of illumination to rejuvenate, heal, and uplift, could be used constructively within the built environment. A generous distribution of light-filled spaces would provide joyous regions for daily replenishment of one's emotions, spirit, and energy levels.

Similarly, it is vital to provide occasional zones of

darkness for physical and emotional relief from the continual shower of sensory stimulation outside. These places provide a different kind of rejuvenation, by means of rest rather than life. It is in these places also, that the light of night, of luminous beacons within an undifferentiated void, can be present during the day. In such places, the contrast of light and dark is amplified to the extreme, enabling highly localized spaces collected around 'private' light sources. These result in small, focused, personal spaces not of the outside world, spaces which, by reversing the light field from outward to inwardly focused, create small personal worlds of belonging.

Dark regions lit by small, intense lights, are important also as counterparts to the luminous regions. Extended exposure of the photochemical systems of the eye to light stimulation results in a depletion of rhodopsin, the material which absorbs the light. This results in decreased sensitivity which can only be reversed by regeneration of the rhodopsin in the dark.[6] This cannot occur if the entire field-of-view of the eye is illuminated.

We need portions of that field to be dark in order to avoid eye fatigue; thus as the pattern of light receptors on the retina receives changing patterns of light and dark areas, individual receptors are able to be alternately bleached and regenerated through time. The presence of these two zones is vital, then, for soothing the eyes and providing both contrast and foil to light-filled regions. They provide areas of coolness in hot weather, and create zones of shadow and depth for interior landscapes. Without these dark regions of space, the luminous zones would be most oppressive and straining. Also, as the basis for music is the presence of silence, the world of light is dependent upon darkness to give it definition and form, and a quiet matrix within which to come alive.

An additional strong association which is connected to illumination is the animation of surfaces; even surfaces with which we have negative associations will often come alive in the sunlight. If one finds oneself within a field of highly intrinsic surfaces on a sunny day, such as the richly colored walls of an old medieval street in Rome, or the hot colored autumn foliage of the Vermont

woods, one's inner illumination evoked by the light alone is compounded many times by this stirring overlay of color and textural qualities. By reinforcing natural sequences of sunlight luminance and color with surface tonal values, color, and texture, these heightened qualities of luminousity can be easily achieved within interiors. In specially designated places, hot-colored surfaces can receive the grazing orange light of the rising or setting sun, and white surfaces can receive the white midday light, resulting in occasional zones of highly intensive light resonance.

A consideration of natural illumination which has been left to last, and yet which is generally the only discussed function or consideration of daylighting in buildings, is the provision of light for vision, for the performance of visually related activities. Both the current scarcities of energy with which to generate artificial lighting, and the presence of an abundant, free, high quality supply of natural light during the day, suggests that we should find ways to exploit the potential of daylighting to the maximum. This could result in an architecture in which

illumination during the day is almost completely satisfied by means of built decisions which enable necessary flows of light throughout interior regions. This has been accomplished many times within small, isolated buildings such as private homes and small schools. But to generate these qualities at a dense urban scale, where it is most needed, will require a much richer vocabulary of built-light, in which decisions of light distribution are positively made at all stages of physical assemblage.

1. Light-Framework

The large, opaque, 'primary' definitions of a building, for example the large structural load-bearing stuff that is the first to get built (big concrete panels, concrete and steel frameworks, etc.), function in terms of natural lighting as light-frameworks or light-distributers. They establish basic, large-scale light flows, and go very far to create the limitations and potential of the smaller scale light modulation which follows (smaller frameworks, panels, blocks, filters, screens, reflective surfaces, etc.). Thus a relatively deep 'layer-cake' construction 1
cannot be ameliorated by the most ingenious light modulating decisions to follow, for this large light-template has cut off the light flow from all but the edge region. Conversely, the more light-catching edge and the 2 3
greater the amount of effective light paths through this 4
initial construction, the more one has opened up the possibilities for an equitable and humane distribution of natural light throughout the building. Specific limitations for extreme climates (hot-humid, hot-arid, and cold) are discussed in the section on light and heat: the following pertains to temperate climates.

A primary limitation on horizontal spans of 2-sided slabs or platforms, is the cutting off of access to light from the sky vault for spaces underneath. Using the minimal amount of light necessary to comfortably read printed material (approximately 10-20fc.), the angle of skylight access should be in the neighborhood of 30°.[9] This would correspond approximately to a ratio of 1:2 between vertical window height and width of space. Thus where window heights (or lateral openings) are 8' and occur on only one side of a space, the slab width above should be in the neighborhood of 16'; if these same window dimensions occur on both sides of a space, the width might approach 32'. Where spacings between slabs are generally 8'-10', one would expect a limit of approximately 30' in the shortest direction; an additional slab could be added to the c. 30' one, if it were sufficiently displaced. Relatively dense non-packing growth forms could be generated, while still maintaining sufficient natural light distribution.

Continuous surfaces of walls provide valuable dark zones, but in so doing cut off sunlight from spaces on their north side. This can be minimized by generating most

walls either within the center of a growth form, or along the northern edge. Walls also function to deflect light downward, which is facilitated by leaving them free (in places) from support of slabs or platforms.

Columns provide light continuity, and as regions of definition, one would expect them to add up primarily along the south edge, and in a lesser degree along the east and west (due to heat impacts). Just as the wall needs to generate corners to create a pocket of dark, columns need to make corners to create pockets of light. This opened-corner definition, produced by either cantilevered slabs or columns going around corners, will enable (depending upon the infill to follow) sunlight penetration over a greater portion of the day if it is along the outside edge, as well as the generation of light-filled spaces.

2. Roofs

Openings within either shed-roofs or horizontal roof-slabs, the traditional skylight, provide the easiest means of generating vertical light flow. The offsetting of adjacent shed-roofs or horizontal roof-slabs opens

up diagonal paths of light penetration. Both of these methods might follow some rules similar to those of horizontal slab dimensions. One would expect either horizontal or vertical offsets (and thus openings) within a relatively continuous roof surface so as to limit the smallest dimension of a single roof plane to 30' or so.

Where three-dimensional roof forms become entirely glazed, the most intense zone of luminance occurs; so much so that without some additional form of external screening, they become unbearable under the summer sun. These built light qualities found their most articulate expression within 19th century cast iron construction; the conservatories and botanical gardens, the Crystal Palace and Parisian International Exhibitions of 1855 and 1889, the Grandes Halles, the Bon Marche, etc.

3. Glazing/Filters...infill

Clear glazing is a material of visual continuity, and is thus most potent when it creates corners, rather than simply filling a hole in a wall. One benefit is an increase in sunlight access. Most important, however, is the way

several directions of light access can produce a bright, light-filled space, as well as such a wide-angled intake of light that it seems to fill one's eyes. The lateral field-of-view of the human eye is approximately 140°. When this entire field is taking in light, the greatest sense of envelopment by light is achieved. This happens very often outdoors, but can occur indoors as well where glazing extends around corners so as to enable a field-of-view of light up to the 180° of a bay window or the 360° of a greenhouse. Examples of such light definition, in a humane and associable size, include Duiker's Zonnestraal Sanitorium and Maurice Smith's Groton house. 50

Diffusing filters provide continuities of light flow within varied degrees of privacy. The result is a more evenly distributed light from brightly lit translucent membranes; the membrane itself becomes a sunlamp.

Pierre Charreau's Dalsace house of 1930 and the traditional Japanese houses are wonderful orchestrations of diffused light, creating multiple paths of controllable soft luminance. Many paths are sequential in form, so 51 52

that light, once admitted, is kept moving through layers of translucency and transparency.

4. Surfaces

Surface color and texture have the power to suck up the light that is thrown upon it, as a dry sponge would water, completely reflect incident light so as to deny its own existance, or respond 'in-phase' with the light it receives, reinforcing its qualities, and in the most intense cases, generating a resonance of color and luminance which is infinitely more beautiful and overwhelming than either could be alone. It is this quality of light-place which is the epitomy of illumination, which by means of this symbiotic mutual-reinforcement, lifts simply bright or glowing places up to conditions of an almost awesome saturation of energy.

The color of light can either be generated by passing natural light through membranes of selective wavelength, or naturally utilized by orientation toward color sequences along the solar paths. Thus, in the Ravenna tomb of Galla Placidia slices of yellow alabaster throw a saturated yellow light upon adjacent gold mosaics, leaving the blue

shadows to intensify the blue mosaics in the ceiling; in the Greek temple, statues of gold within pools of darkness were oriented to receive the hot orange light of dawn.

Orchestrations of natural white light rely upon large amounts of daylight penetration and families of surface materials which provide high reflectance. In Boffrand's Hotel de Soubise, Fischer Von Erlach's Schonbrunn Palace, and both Neumann's Episcopal Palace and Pilgrimage Church of Vierzehnheiligen, large quantities of clear glass shower interior surfaces ranging from glass mirrors and polished surfaces of wood, marble, and metal, to diffusing whites and pale colored marbles.

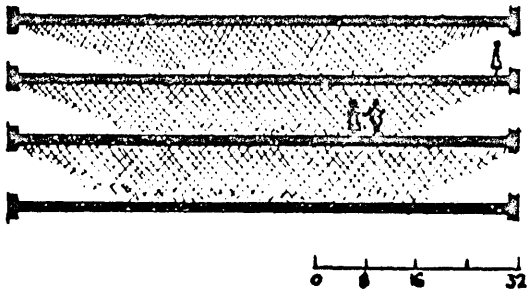
5. Light Conduits

The light conductive properties of glass and acrylic as large scale fiber-optics, would enable them to be used for canalizing sunlight within buildings. These canals could create naturally illuminated physical definitions, and extend the light of the sun to dark interior regions.

Similarly, systems of adjustable mirrors could pick up streams of sunlight along the roof, and channel it

through the building to needed locations. The provision of a light-catching system which follows the paths of the sun through the sky, could provide large amounts of sunlight with which to generate interior sun-lamps and sun-clocks.

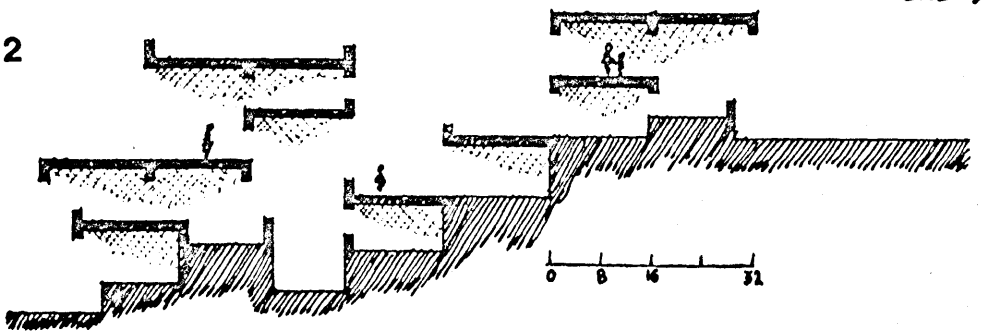
1



THE 'OPENING-UP' AND 'IN-PACKING' OF LAYERED CONSTRUCTIONS RESULTS IN AN ENTIRE FIELD OF POTENTIALLY HABITABLE TERRITORY

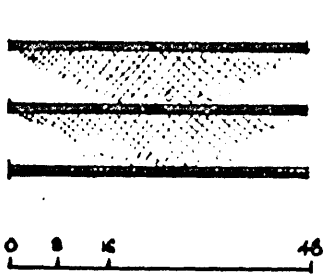
THERE ARE NO / FEW 'DEAD' REGIONS

2



IF THE USE/PROGRAM CHANGES, THE LARGE, 'PERMANENT' LIGHT-DISTRIBUTER CAN REMAIN AS A 'FRAME WORK'

3



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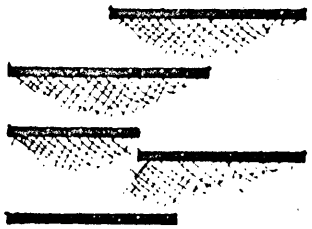
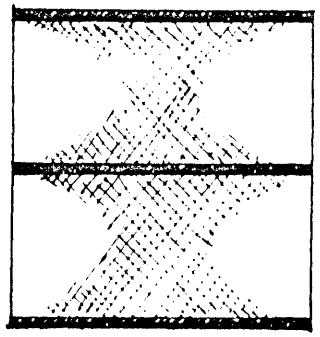
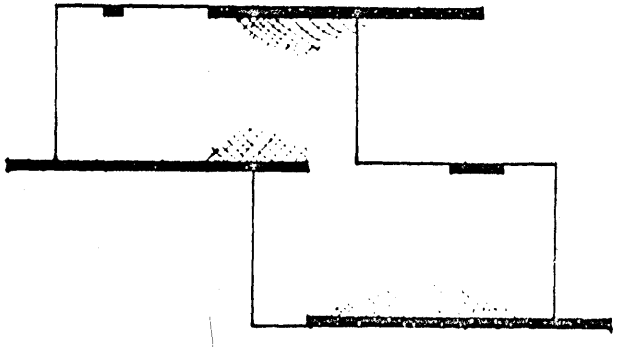


'KNIV-PACKING' ASSEMBLAGES CAN OCCUR IN BOTH PLAN AND SECTION

4

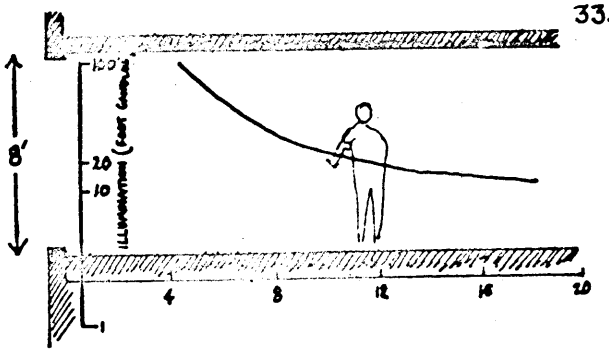


... PLAN →



THERE IS AN INCREASE IN BUILT-VOLUME; IT ALSO:

- CREATES OPEN CORNERS.
- USES WALL FOR REFLECTION OF LIGHT
- WHERE LIVING ZONE BECOMES HIDDEN BY A WALL CAN WORK IN SECTION TO GET LIGHT IN


8'
120
20
10
ILLUMINATION (FOOT CANDLES)
4
8
12
16
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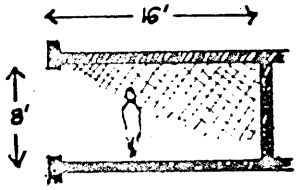
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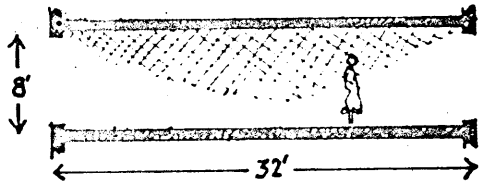
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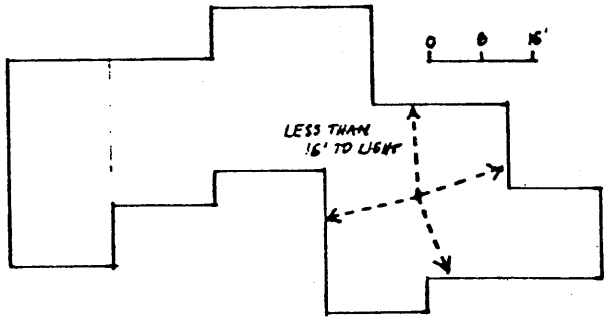
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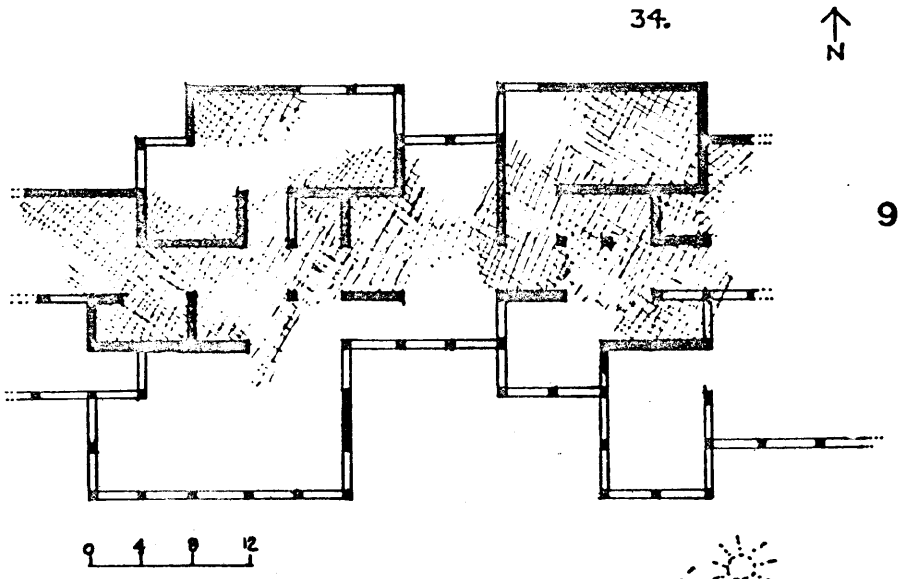

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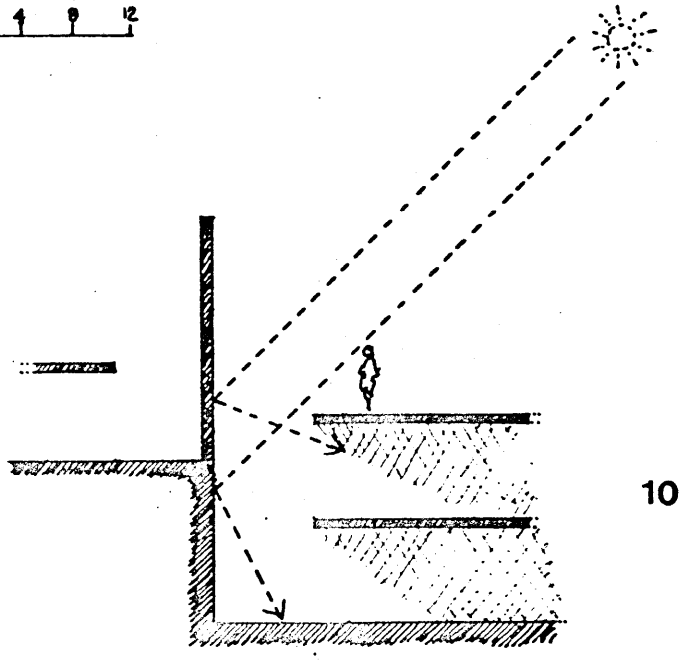

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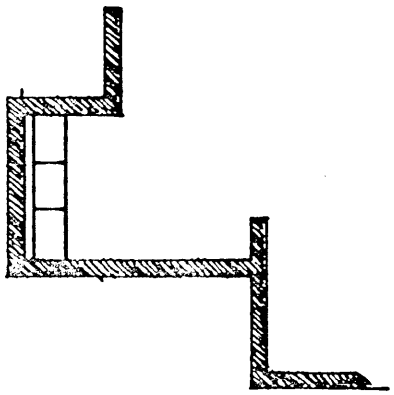

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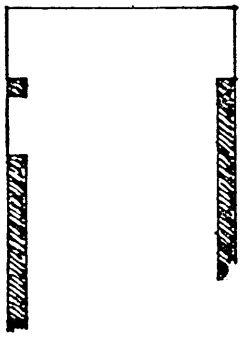

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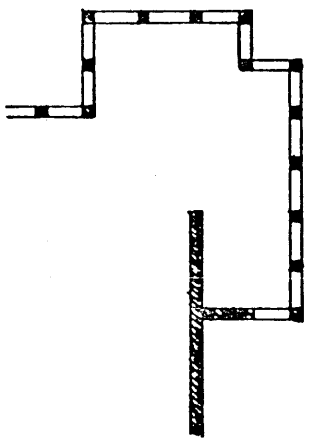

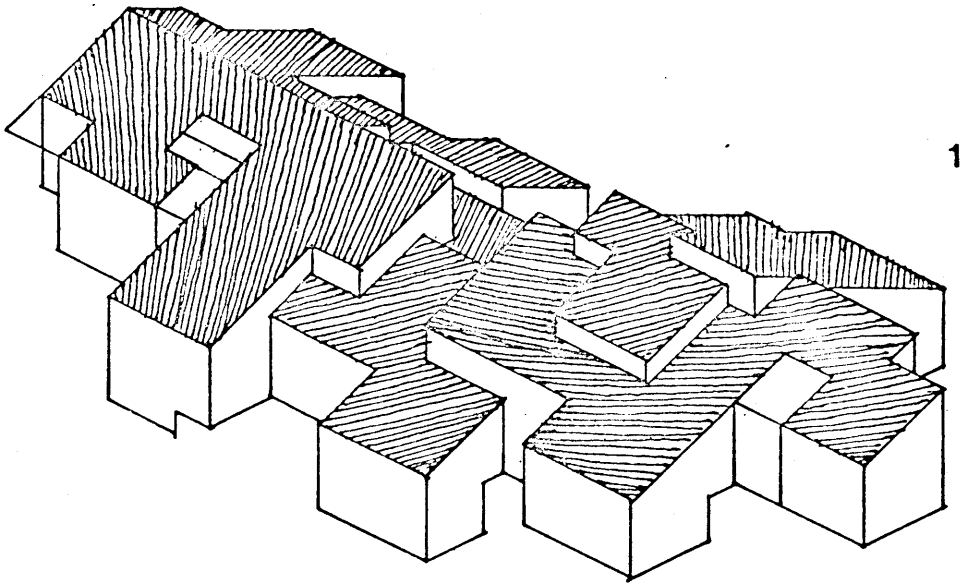

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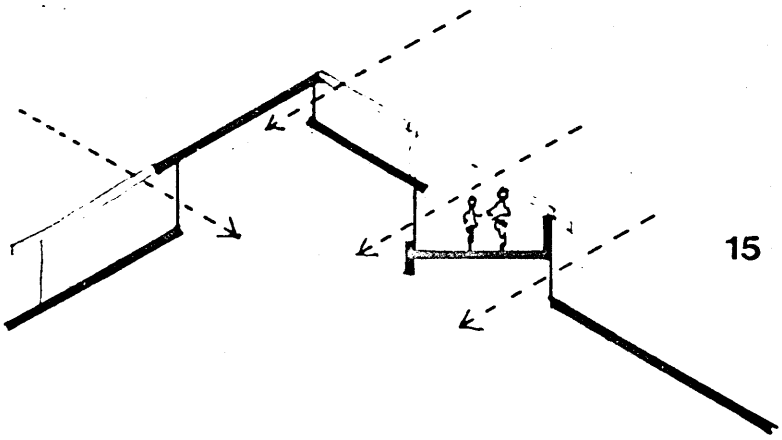

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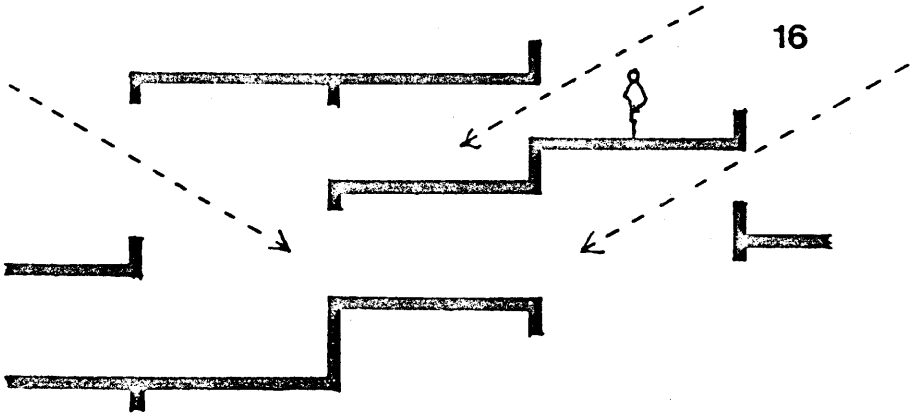

16

2. Sunlight and Place/Sign

(Lights in the Dark)

In the beginning God created the heavens and the earth.
The earth was without form and void, and darkness was
upon the face of the deep; and the Spirit of God was
moving over the face of the waters.
And God said, "Let there be light"; and there was light.
And God saw that the light was good; and God separated the
light from the darkness.

Genesis 1:1

I watched, too, the nights deepen over the scattered islands in our corner of the bay. What a different world they made. On a moonless night the sky ceases to exist; its place is taken by the enormous firmament of stars, bright in an immense, black infinity of space. When the wind is down and phosphorescence runs high, the glow of myriad organiams softens the cold fixed reflections of the stars, sunk deep in the inky water. Night is a simplification: the world is drawn down to its bare essentials and the distracting details disappear, leaving only the bold outlines of objects. But the black emptiness of night is peopled by the uninhibited imagination, and mystery crowds in wherever the imagination is given scope. The most familiar places, only dimly perceived in the dark, change their dimensions and content so radically that one begins to expect completely unrecognizable things to ooze out of the blackness.

Eliot Porter

Before the light vanishes, we pray you, creator of all things, to hold us in you keeping. Withold from us nightmares and phantoms of the night, keep back the enemy that our bodies go unpolluted by him.

St. Ambrose

He stopped than at a closed door behind which a voice sang the glory of God with so much sweetness that one might know it was not the voice of a mortal man....Then of itself the door opened, and from within came a great light, so great that it might have seemed the whole sun within that room sending out its rays....

La Zueste del Saint Graal

The presence of a formally defined pool of light within a field of darkness is one of the most highly symbolic and evocative environmental phenomena known to man. From the beginnings of history, the juxtaposition of light and dark have had meanings derived from the most awesome questions man has ever posed of his origins and future, of his tenuous place in the cosmos.

The generation of a light in the dark probably has its earliest and most profound articulation in accounts of the Creation, of divine light transfiguring the darkness of matter.

> Darkness there was: at first concealed in darkness this all was undiscriminated chaos.
>
> All that existed then was void and formless.
>
> Agni Vausvanara, when born as sovran, hath with his lustre overcome the darkness.
>
> A firm light hath been set for men to look on... [10]
>
> Rig Veda (Hindu Scriptures)

Thus the first pool of light was created within a preexisting dark void, as a place for life within a lifeless surrounding. This gift of transitory luminance came with a sufficient amount of uncertainty to strike recurring fear into those receiving it; the rising and setting of the sun, the waxing and waning of the moon, solar and lunar eclipses, and changes of sunlight intensity with the seasons, still serve as constant reminders of its impermanence.

The illumination of the earth within a dark universe becomes an archetype for all other lights in the dark which we experience. Although its religeous connotations may not be consciously prevalent, our associations with such light pools as welcome places of reference and hope remain. They become worlds of belonging within the unknown of the dark: the lamp in the window on a dark night, people huddling around a fireplace or bonfire, the sighting of a lighthouse

after days at sea, the intimate space of a candlelight dinner, all evoke related place associations.

Light pools which are potentially habitable, but at great distance, are in many ways the most intensely evocative. They and whomever occupies them become our companions; although we may never see them, their presence is both consoling and reassuring, for they are signs of the collective unity of life, of potential friends within the uncertainties of urban and cosmic experiments: within the city, the sky, and the depths of space. The nightscape of the city seen from either sky or skyline, of car lights from a distance, of ocean liners at sea and aircraft in the sky, of airports, of lamps in the window at a distance, of the moon, planets, star systems, and galaxies, are all stirring evidence and reassurance of the plentiful and benign distribution of life.

Tiny lights in the dark, such as candles, torches, street lamps, neon signs, water reflections, reflections in water droplets, lightning, fireflies, fireworks, sparklers, become metaphors of light worlds; they are the suns, moons and nebulae of a smaller landscape.

The potential of light pools to nodalize a space and to create a highly associable focused zone within the dark, enables them to function as signs of direction, orientation, summons, warning, the occurance of events, etc. Though it is nearly impossible to disentangle the overlays of meaning these light beacons have evoked throughout history, there are some differences in the information communicated which differentiate them.

Markers of location and direction were probably one of the first uses of light in the dark, particularly for the fixing of sighting lines for celestial events such as special rise or set points of those godlike forces of prehistory, the sun, moon, planets, and stars. Such precise alignments would provide man with a cosmic calendar, with which to reckon forward to the times for plantings and harvests, hunting, and other vital concerns. More recent locational light beacons include entrance lights to buildings, the advertising lights of commercial establishments, and the wonderful colored lights of airport runway markers. Related light markers which transcend simple informational meanings, and become symbolic markers of the presence and remembrance of life as well, include outdoor lights of homes

and the lights of burial sites. The interior use of natural light to clarify orientation occurs in Herman Hertzberger's Montessori School in Delft:

> ...The most active and complex point of the building is where the classrooms and hall open onto each other. These are the points where the children will work in the hall as though outside in front of the house on one's own ground...It is at these points that the roof domes let in daylight...[11]

Some particular bright pools of light have been considered to be a direct manifestation of, or signal from, God.

> ...When they had heard the king they went their way; and lo, the star which they had seen in the East went before them, till it came to rest over the place where the child was. When they saw the star, they rejoiced exceedingly with great joy; and going into the house they saw the child with Mary his mother, and they fell down and worshiped him.[12]
>
> Matthew 2:9

> ...the swift flash of lightning rending the darkness has been given the value 'mysterium tremendum' which, by transfiguring the world, fills the soul with holy terror. Men killed by lightning are considered to have been snatched up into heaven by the storm gods, and their remains are worshipped as sacred relics.[13]
>
> Mircea Eliade

The potential of light to signify divine presence has been

used effectively in many religeous buildings. In the great rock tomb o Ramesses II at Abu Simbel, the orientation of the long entrance passage is such that the only direct sunlight which penetrates the entire length is that which occurs on the morning of the god's feast day, only one day a year; most dramatic is the fact that all figures at the rear are illuminated but one; the god of darkness. In a small chamber in the Temple of Ptah, at Karnak, an opening in the ceiling functions as a 'camera obscura' by projecting a blue cone of light on the divine statue below. Thus within this dark space is a single illuminated statue animated by the blue sky and passing clouds outside:

25

17

> ...The faithful could no longer doubt that their prayers were heard or rejected when they saw the 'divinity' become animate, turn white, blue, and out of the white light advance silently toward them, then suddenly disappear...[14]

Legrain (1916)

And finally, what must have been a most spectacular use of finally focused illumination, is an ancient Egyptian statue of King Zoser, whose eyeballs of inset rock-crystal receive light from small openings in an opposite wall.

These examples of lights in the dark, which were created in Egypt about 4000 years ago as a means of building into sacred

places some rather dramatic equivalents of divine illumination within the dark, have found countless analogous modulations throughout history. Two of the better known examples are the 13th century stained glass windows of the Ile-de-France and the brightly lit lanterns and domes of Bernini, Borromini, and Guarini in Baroque Italy. In Bernini's S. Andrea al Quirinale, the light pool becomes strongly colored, as yellow stained glass brightly saturates the space within the lantern, and then flows down to illuminate similarly colored gold surfaces in a continuous fugue of golden light.

23

Representations of pools of divine light occur frequently in medieval illuminated manuscripts, in which actual gold leaf and jewels provide tangible areas of light within a two-dimensional plane. Later paintings by Leonardo, Tintoretto, Caravaggio, and Rembrandt provide more pictorial instances of both glowing and blazing divine light in the dark.

Light beacons which signal warnings include light markers on bridges, tall buildings, urban construction sites, cars, ships, and the flashing lights of lighthouses, ambulances, tow trucks, police cars, and searchlights. The most evocative light warnings, however, have come from the sky. To nearly every

comet visible to the naked eye, in all but the most recent recorded history, man has lain the blame for some disaster: war, massacres, the black plague, floods, assassinations, or earthquakes. Comets have been looked upon as omens of terror and evil. Powerful men who lived at the time of a visible comet have been associated with them. The comet of 43 B.C. was supposed to have been the soul of Julius Ceasar transported back to heaven; other comets have been associated with the coming of William the Conqueror (in April of 1066) and Napoleon (the comet of 1811-1812).

Temporary of highly manipulatable light beacons have been used to convey messages, such as the codified light emissions between ships at sea, the famous signal from the Old North Church at the beginning of the American Revolution, traffic lights, and the imagery of television.

The most joyous lights in the dark are those connected with celebrations. Several of the oldest examples include the lighting of huge fires in ancient continental Europe to signal the death of winter at what is now Easter and the turning point of the sun at the winter solstice. The date of Christmas was 'arbitrarily' established to replace this

winter festival, Christian theology being centered upon the Incarnation, which in the Gospel of St. John is perceived as light illuminating the world. Christmas tree lights must be a vestige of the earlier 'pagan' ceremonies.[15] Fires, torches, and candlelight have additionally been used to celebrate military victories and harvest festivals, of which the latter can still be observed in rural Japan. Modern day counterparts include fireworks, sparklers, and bonfires of Independence Day in the United States and Guy Fawkes day in England.

Our associations with these various light-worlds vary significantly with differences in the darkness which surrounds them. They seem to first start to come alive at twilight or at any time on an overcast rainy day. At these times they are like the wildflowers in the open fields, intense areas of reference but not yet the dominant, perceptually overpowering qualities they become at night.

Changes in our physical location with respect to particular lights in the dark, also have a drastic effect upon our resultant associations with them. When we are still outside of a region of light, but close enough to identify its qualities,

meanings, and the hospitality of those in it, such as when approaching a bonfire from across a field at night or entering a large dark room at the other end of which is the warmth of a glowing fireplace, we can projectively associate with our possible immersion in it although we are still acutely aware of the darkness surrounding us. Some of the early drawings and recent paintings of Gyorgy Kepes provide two-dimensional examples of this light quality; through what read as dark screens are seemingly distant regions of intense luminousity, sometimes gay and bright and at other times hot and smoldering, as if there were some molten substance within the canvas. Related filds of light are often found in the photographs of Eugene Meatyard and Minor White; while the former often weaves a story between a brilliant splash of sunlight and the dark landscape of people and building surrounding it, the latter frequently creates images in which the dominant forms are animate light-filled surfaces which transcend given landscapes into magical worlds which resonate with and feed our own light-starved interiors.

In contrast to external viewing of a pool of light, once we are within it, whether it be the illuminated entrance to a house or the candlelit space of a dining table, we become

submerged in, and filled with, the light and warmth of this localized region, securely isolated from the dark void around it. In the largest scale, this is what happens during the daylight hours, as we are temporarily immersed in a very large pool of light. Many of the landscape photographs of Ansel Adams provide us with such light saturated worlds which we can temporarily explore and inhabit, and in the process, absorb some of its luminous substance.

In contrast to these identifiable light zones, are the tiny lights we see at a great distance, little worlds of uncertain size which may or may not be inhabited. A sense of mystery and fantasy pervade these minute regions; we are immeasurably separated from them in time and space, and yet they make up the distant landscape of our own personal world. Nightscapes of the city, the sea, and the sky, little lights which may signify a home, a nocturnal traveler, a holiday cruise, a cross-country drive, a weary commuter, and just maybe, far-off, a world of life light-years away with which to someday share the joys and uncertainties of our cosmic existance. In many ways it is these distant lights which give us the most comfort, for their very ambiguity and inconclusiveness leave us with a measure of hope and optimism

for the collective unity of life.

Probably the most profound, inherent associative capacity of lights in the dark, is their ability to evoke movement toward them. Since it is very easy for us to project ourselves into them, in a kind of psychic, surrogate movement, we do not have to physically respond, as a moth to an open flame. The majority of our movements into pools of light are by this means, which fortunately seems to satisfy this primordial impulse. Where both surrogate and actual physical movement towards these lights in the dark occurs, they are accompanied by highly insistant forces of attraction, as though one were in actual fields of force analogous to that between magnets of opposite poles. I think that this almost overwhelming attraction must be rooted in primitive man's strivings for safe and supportive places to live, which had its conceptual beginnings in his accounts of the creation of his larger world by the generation of life-giving light within a dark universe, and which has been constantly reinforced ever since by experiences of terror and danger in the dark, and sustinance, growth, and nourishment in the light. This stimulus for both actual and projective movement was effectively used in the design of Medieval and Baroque churches; bright regions of

light were placed at the sacred ends of spaces in order to elicit 'movement', horizontally in one and vertically in the other, thereby generating a physical experiential parallel to the performance of the ritual, each providing a different (but ultimately cumulative) means of divine interaction and devotion. 23 24 48

This power of pockets of luminance within a dark matrix to evoke both movement and strongly associative places, can be employed within buildings and the outside urban environment (there is already an abundance of such places in the natural world), to generate sequences and adjacencies of contrasting variations in spatial luminance. One of the reasons that the modern city is so lifeless, is that this experiential variety has been replaced by a homogeneity of uninteresting light. Urban sequences of narrow dark streets and brilliant light-filled spaces, as occur in the old covered streets of Fez, Moulay Idris, and Marrakesh (Morocco), Perugia, Siena, Treviso, Padua, and Bologna (Italy), provide strong and immensely rich experiences which play on all the senses: 18 19 20 21 22

> ...sheafs of light piercing darkness; waves of coolness and warmth; the echo of one's own footsteps; the odor of sun-baked stones. The sum of these impressions adds up to an esthtic adventure that,

modest though it is, we are usually denied...[16]

The generation and focusing of highly associative public regions of light and dark, provides a means of strongly sensed identification with a pattern of personally meaningful loci, and gives the citizen an internal understanding of, and association of belonging within, a complex physical environment. Without these associable variations, all local places become the same and merge into a sea of nothingness, in which it is nearly impossible to feel that the place you are in at any point in time is any different than another. I would guess that the effect is similar to that produced within experiments of sensory deprivation, such as immersion within a pool of continuous water; in each, one 'floats' without significant perceptible sensory contacts or interactions. Just as it would be unthinkable to exist for any length of time in a situation of unchanging acoustic, olfactory, tactile, or gustatory conditions, it must also be unhealthy to remain in places of constant light conditions.

> ...Prolonged exposure to a monotonous environment, then, has definitely deleterious effects. The individual's thinking is impaired; he shows childish emotional responses; his visual perception becomes disturbed; he suffers from hallucination;

> his brain-pattern changes...a changing sensory environment seems essential for human beings. Without it, the brain ceases to function in an adequate way, and abnormalities of behavior develop. In fact...'variety is not the spice of life: it is the very stuff of it.' [17]
>
> Woodburn Heron: "The Pathology of Boredom"

The buildings of Frank Lloyd Wright provide examples of much needed interior juxtapositions and sequences of bright and dark pools of light, often with dark entrances and corridors opening onto luminous living spaces. The sad opposite extreme can be found within the quantities of continuous pathological seas of even light produced by modern illumination engineering, which is unfortunately what most of us have to live and work in.

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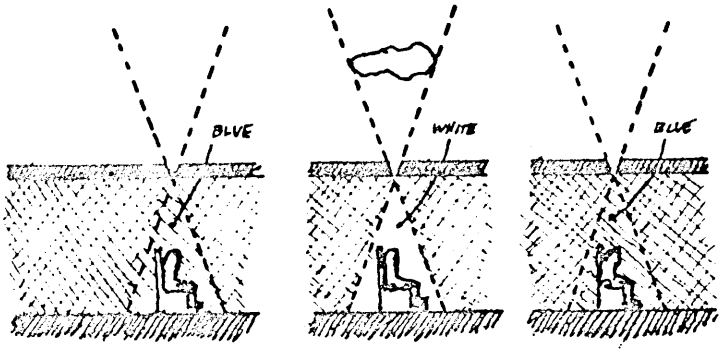
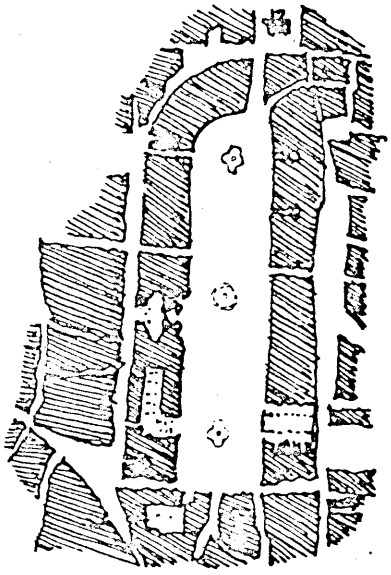


TEMPLE OF PTAH · KARNAK



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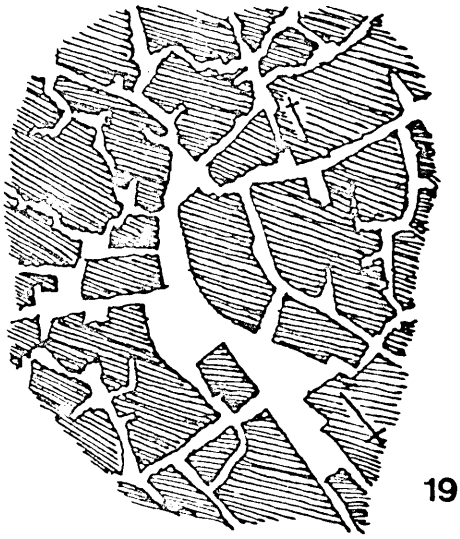
PIAZZA NAVONA
FROM NOLLI



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MARTINA FRANCA - APULIA
FROM RUDOFSKY

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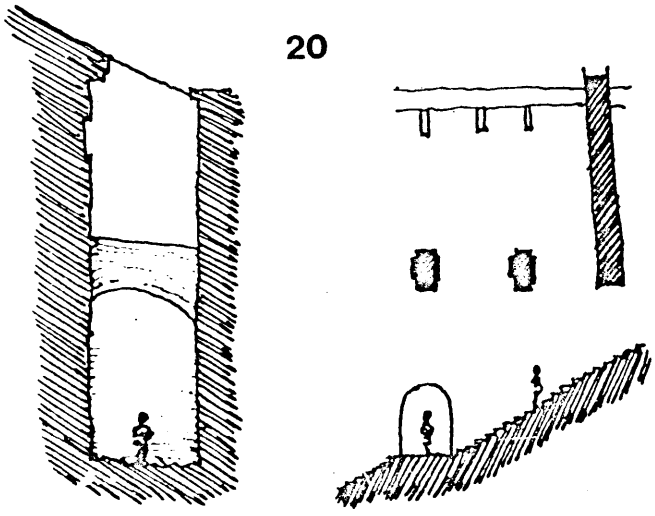

MATERA

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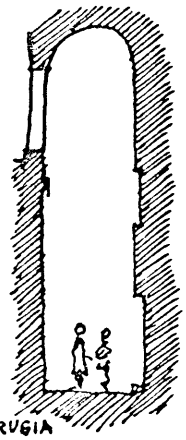

PERUGIA

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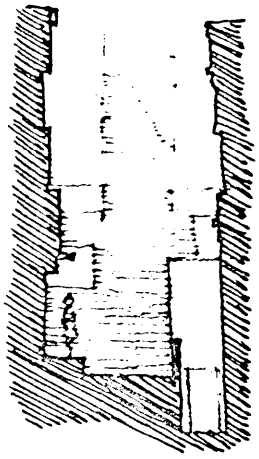

SPERLONGA

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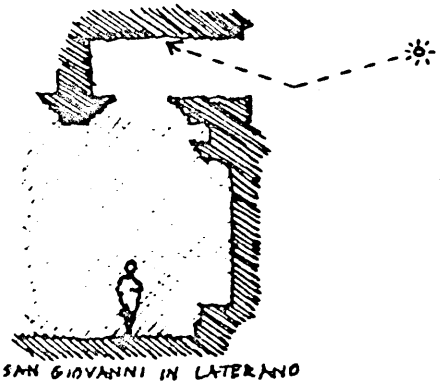
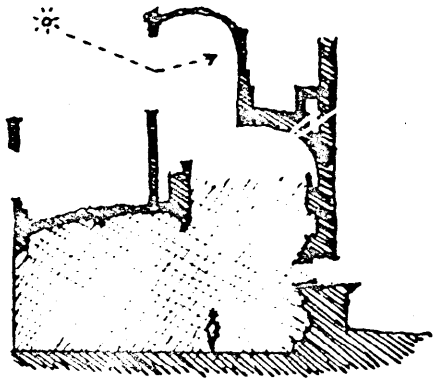


CHAPEL - SAN GIOVANNI IN LATERANO

24



TOLEDO CATHEDRAL

3. Time

Linnaeus Flower Clock

6 A.M. - Spotted Cat's Ear opens
7 A.M. - African Marigold opens
8 A.M. - Mouse Ear Hawkweed opens
9 A.M. - Prickly Sowthistle closes
10 A.M. - Common Nipple Wort closes
11 A.M. - Star of Bethlehem opens
12 A.M. - Passion Flower opens
1 P.M. - Childing Pink opens
2 P.M. - Scarlet Pimpernel closes
3 P.M. - Hawkbit closes
4 P.M. - Small Bindweed closes
5 P.M. - White Water Lily closes
6 P.M. - Evening Primrose opens

Carolus Linnaeus (1707-1780)

What is the value of preserving and strengthening this sense of awe and wonder, this recognition of something beyond the boundaries of human existance?...There is symbolic as well as actual beauty in the migration of the birds, the ebb and flow of the tides, the folded bud ready for spring. There is something infinitely healing in the repeated refrains of nature - the assurance that dawn comes after night, and spring after the winter.

Rachel Carson

A natural discipline and intrinsic rhythm establishes itself, free from the strains and tensions of clock-watching. You have a sense of abiding by broad universal laws rather than of being bound by narrow and arbitrary rules. You feel free of bondage and yet secure in an order that governs the rest of the world around you - the march of fogs from the sea, the mating of foxes in the spring, the migration of birds in the fall. The pendulum of the clock has nothing to do with you, nor have its sweeping hands. Only the great pendulum of the tide can drive you away from the sand bar where you have been gathering blue mussels; only the slow hand of the declining sun can call you home from mulberry-picking on the heath. You experience the sense of well being that comes from complete harmony with your surroundings, and you find it good.

Louise Dickinson Rich

...one's first appreciation is a sense that the creation is still going on, that the creative forces are as great and as active today as they have ever been, and that tomorrows morning will be as heroic as any of the world. Creation is here and now. So near is man to the creative pageant, so much a part is he of the endless and incredible experiment, that any glimpse he will have will be but the revelation of a moment, a solitary note heard in a symphony thundering through debatable existances of time...It is impossible to live without reverence as it is without joy.

Henry Beston

And God said, "Let there be lights in the firmament of the heavens to separate the day from the night; and let them be for signs and for seasons and for days and years...

Genesis 1:14

This grand show is eternal. It is always sunrise somewhere; the dew is never all dried at once: a shower is forever falling: vapor is ever rising. Eternal sunrise, eternal sunset, eternal dawn and gloaming, on sea and continents and islands, each in its turn, as the round earth rolls.

John Muir

Now comes sundown. The west is all a glory of color transfiguring everything. Far up the Pilot Peak Ridge the radiant host of trees stand hushed and thoughtful, receiving the Sun's good-night, as solemn and impressive a leave-taking as if sun and trees were to meet no more. The daylight fades, the color spell is broken, and the forest breathes free in the night breeze beneath the stars.

John Muir

Natural light provides us with direct connections to the realities and movements of celestial bodies, which are our primary source of time in the universe. Cyclic patterns of movement in the sky overhead, of sun, moon, planets, nebulae, and galaxies, along with the dramatically recurring transformations here on earth which parallel and result from their particular locations and interactions, emersed pre-industrial man within an accessible and lucid matrix of time. The perceived causal relationships between celestial processes and earthly conditions evolved into religious rituals, myths, symbols, and divine forces in both primitive races and the earliest civilizations of

history, cosmic hierophanies of the sky, sun, and moon. The sun, providing time during the day with its daily and seasonal paths through the sky, is complimented at night by the slow nocturnal rotation of the celestial sphere and the annual march of its constellations, the waning and waxing of the moon, the rise and fall of the tides, and the increases in meteor showers toward morning, as we revolve toward the forward side of the orbiting earth.

The cyclic web formed by recurring patterns of kinetic celestial bodies shows increasing evidence of being directly connected to rhythms of life here on earth. Since the beginnings of man's history, human thought has been permeated with this belief, as a result of his cumulative observations over many thousands of years. These astrological ideas were the basis for most of man's religions; although we have temporarily broken the continuity of this ancient knowledge, it is beginning to reemerge, curiously enough, through recent biological studies.

The periodicity of seasonal cycles, with their resultant patterns of alternate increases and decreases in both light duration and intensity, have entrained and synchronized a

variety of parallel biological oscillations. Plants and insects are able to count changing seasonal ratios of light and darkness through variations in internal metabolic cycles, which are calibrated according to inherent rhythms of light receptivity; this inherited time-structure schedules life-dependant sequences of dormancy, growth, flowering, and breeding.[18] Birds and mammals undergo similar (but more complex) cycles: the winter hibernation of bears and squirrels, the changes of fur color in the weasel, and the annual sequences of birds, seals, and whales, which respond to autumn days by becoming nocturnal and increasing their fat deposits, then migrating and breeding followed by another period of inactivity and molting as they build up fat for the return migration.

Although we don't yet have much scientific data of related seasonal changes in human beings, there are too many indications of its occurance for them to be accidental. It appears that light which enters the eye travels a route along the optic track, and is then transfered to nerve signals which act on the neuro-endocrine system. The endocrine glands, which secrete hormones, play a major role in metabolism and are therefore crucial for normal physical

and mental development, for reproduction, and for the maintenance of homeostasis.[19] Laboratory studies have already confirmed some specific repercussions. Those who have severe cataracts, along with the blind, show a whole range of metabolic disorders, which are often relieved by eye surgery.[20] The pineal gland, which seems to play some role as mediator between incoming light and the signals involving sexual reproduction, is directly affected by light from the moment of birth on and it may possibly accelerate it's development; since the pineal appears to provide some restraint on gonadal development, amounts and qualitites of environmental light may affect ages of sexual maturation.[21] Studies of the timing of menarch, first menstruation, show it to occur most frequently in winter, and that blind girls reach it earlier than girls with sight.[22] Studies in Finland, with it's long dark winter, have shown that conceptions increased, and the pre-tumerous cell growths called hyperplasias decreased, during the few annual months of intense sunlight.[23] Spring fever, and the fact that human beings tend to mate more in spring and summer, may be partially due to increased sunlight and glandular stimulation in those seasons.

Our most commonly understood seasonal changes occur in the form of emotions, moods, energy levels, weight fluctuations, and illnesses. Many people sleep more during the winter, put on additional weight, and experience 'winter doldrums'. The neuro-endocrine system, being the mediator of moods, may be responsible for commonly experienced seasonal feeling-states: spring fever, autumnal increases in ulcers and allergies, winter depression.[24] The stereotypes of the moody Scandinavian and the joyful Italian may begin to be explained by extended immersion in either a depressing lack of sunlight, or within a constant wonderous shower of it.

Changes in light intensity through the day and night, the circadian cycle, are a primary synchronizer of activity rhythms. Day-night cues even exist in what appear as continuous light conditions in the Arctic, where indigenous animals are 'surprisingly' able to detect minute changes in light level in order to calibrate their daily cycles.[25] Studies with diurnal (birds, mammals, and man) and nocturnal (mice, rats, and cats) animals, show that diurnal creatures orient their activity around the times when light is present, shifting toward it when it is delayed in the

laboratory, while nocturnal animals do exactly the opposite.[25] With the lengthening days of spring, diurnal animals awaken increasingly earlier, while nocturnal animals shorten their activity period. This is also true for many people, who seem to rise earlier and more voluntarily with the lengthening of days and the return of light.

Moon cycles, consisting of both light and gravitational sequences, are believed to be directly connected to the mating cycles of many marine animals, and may have become part of the time structure of mammals.

> The swarming, spawning, mating of many sea creatures is related to the rhythms of the tides, which grow stronger when the sun and moon are in opposition or conjunction. In spring in Bermuda, at the time of full moon, the surface of the sea becomes brilliantly luminous with the swarming and breeding of the Atlantic fireworm. Along the Southern California coast, between March and August, grunions spawn on the flood tides of night after the full moon.[27]

Laboratory studies with sea worms reveal that sexual development can be evoked simply by reproducing the lunar cycle with a dim artificial light.[28] The similar periods of menstrual and lunar cycles (approximately 29 days) might be a vestige of the way primitive organisms were entrained by the moon; this likelihood is reinforced by the belief

that all life came originally from the primordial sea. Recent scientific studies with young women afflicted with menstrual irregularity demonstrate that their conditions can be cured by particular environmental light regimens.[29] Immersion in night lighting on specific portions of the cycle seemed to resynchronize ovulation. It may be that, as the calibration of a rat's estrous cycle requires light reception within two critical hours, that there is also a critical period within the woman's cycle.

> The data are preliminary, almost so sketchy as to be anecdotal, yet the possibility of entraining the ovulatory cycle by light, and entirely without drugs, is too exciting a prospect to abandon. The hypothesis is crude, but it suggests that we may find we are like photoperiodic plants and creatures, tuned to earth's rhythms by the potent synchronizer - light. It helps to shape our alternations of activity and rest, enters our unwary heads, and influences our circadian rhythms of adrenal hormones, our daily rhythms of metabolism. Even skimpy evidence from studies of the blind and gynecological examinations of Finnish women suggest that light affects the pituitary, the master gland of reproduction and metabolism. Each day light may synchronize our behavior and bodies with the earth's rotation. The slowly changing ratios of daylight and darkness may guide our physiology, our hormonal systems in tune with the seasons, causing our moods, symptoms, sexuality, and the condition of our reproductive organs, to change slowly in an annual rhythm, and bring us along with the earth without sudden transitions.[30]

It is not surprising that since ancient times the moon

has been identified with fertility. In addition to its observed connections with reproductive cycles, it is a body which waxes, wanes and disappears, which is constantly in a process of periodic regeneration. This ever recurring cycle makes it the celestial body most identifiable with the rhythms of life, fertility, waters, rain.

> The phases of the moon showed man time in the concrete sense - as distinct from astronomical time which certainly came to be realized later. Even in the Ice Age the meaning of the moon's phases and their magic powers were clearly known. We find the symbolism of spirals, snakes, and lightning- all growing out of notions of the moon as the measure of rhythmic change and fertility - in the Siberian cultures of the Ice Age....The oldest Indo-Aryan root connected with the heavenly bodies is the one that means "moon": it is the root 'me', which in Sanscrit becomes 'mami', "I measure"....Time as governed and measured by the phases of the moon might be called "living" time. It is bound up with the reality of life and nature, rain and the tides, the time of sowing, the menstrual cycle.[31]

Moon cycles governed the rites of planting, circumcision, and fertility in ancient Egypt and Africa. French peasants continue, even today, to sow at the time of the new moon, and harvest when it is on the wane.[32] Moon symbols include an oxen's horns (an image of the new moon's crescent); animals which undergo apparent regeneration: the snail in its shell, the hibernating bear, the submerged frog; the serpent, which is identified

with fertility and copulation.[33] In our times, the effects of increased barometric pressure at the full moon may be responsible for sudden rises in the excitability of some sensitive people, which is manifested in rises of crime and psychiatric admissions ('lunacy') at that phase of the lunar cycle.[34]

The growing evidence of an internal human time structure which affects our entire physical and psychic well being, may be partly a vestige of times in human and biological evolution when there was a more obvious survival value in being calibrated with natural cycles. These internal rhythms probably began to evolve simultaneously with the emergence of life on this planet, within a world of daily alternations of light and darkness, annual lengthening and shortening of days, and monthly sequences of changing barometric pressure and the ebb and flow of the tides.

> This important rhythm of energy, from light, must have influenced life for hundreds of millions of years. Rhythmicity was probably one of the first forces of natural selection, since the organisms that timed their activity and life processes in accord with light, temperature, and humidity cycles would have had an advantage in survival. It would be altogether strange if this long evolution had not left its trace on mankind....we are bombarded by the periodicities of earth, and in its helicoidal, screw-like course around the sun, to constantly

> shifting galactic fields. The cosmos has hourly, daily, monthly influence upon our existance.... Unlike our astrological ancestors, we have many options and many new instruments that can expand our dialogue with the cosmos around us. Instead of being buffeted by invisible tempests of particles, and residues of galactic winds, we can choose to identify these messages from the universe and find in them our link to cycles beyond the solar system ....The time-structure of our bodies is, after all, only partly within our skins, for we are open systems, unable to detach ourselves from the beats of this nature of which we are part.[35]

Up until recent centuries, man has been acutely aware of these internal ties, and created an incredible range of cyclic celebrations with which to intermesh their periodic repercussions within his daily life. These rituals, both built and performed, served the direct purpose of appeasement to the 'mysterium tremendum' and 'majestas' of divine power, which occasionally manifested itself in acts of divine wrath.

A possibly indirect consequence of these ritualistic conciliations, which in the long run may have even been more important in maintaining the sanity of primitive man within a frighteningly unfathomable world, was the establishment of recurring fixed points of temporal orientation within the continuities of life. Eliade has

discussed the analogous necessity of establishing spatial orientation:

> Revelation of a sacred space makes it possible to obtain a fixed point and hence to acquire orientation in the chaos of homogeneity, to 'found the world' and to live in a real sense. The profane experience, on the contrary, maintains the homogeneity and hence the relativity of space. No true orientation is now possible, for the fixed point no longer enjoys a unique ontological status; it appears and disappears in accordance with the needs of the day. Properly speaking, there is no longer any world, there are only fragments of a shattered universe, an amorphous mass consisting of an infinite number of more or less neutral places in which man moves...[36]

If we replace the word 'sacred' with the word 'associable', we may have a more easily understood description of today's world, which would apply equally to the need for associable (or sacred) loci of time, as well as to those of space.

Examples of time celebration throughout history are staggering in their frequency of occurance, both in time and space, and in the immensity of effort and investment that went, and in some places continues to go, into their generation.

The earliest 'archeological' indications (as opposed to rituals of renewal, which wouldn't have involved the

generation of permament artifacts) of man's attempts to decipher and resolve the cycles of celestial light events within which he was immersed, occured some thirty thousand years ago with Paleolithic incisions of the bones of mammoth and reindeer, markings which are now believed to be notations of lunar cycles. Recent scientific data connecting lunar cycles with the reproductive and ovulatory cycles of the entire range of earthly biological life, including humans, was 'intuitively' known by primitive man, and found extensive expression within lunar myths, symbolism, and recurring rituals. Present day African Pygmies continue to have their feast of the new moon immediately before the rainy season, a feast which is limited only to the women.[37]

Observation of the paths through the sky of the stars, planets, galaxies, and nebulae at night, and the sun by day, provided a means of calibrating and predicting the patterns of the seasons, and the recurring events which they govern: increases and decreases of luminance and warmth, cycles of dormancy, growth, and reproduction in all earthly life. The ancient Egyptians were able to predict when the Nile would overflow, by observing that

this event occured several days after the very bright star (which we now call Sirius) rose above the horizon concurrently with the sun. Since the sun and Sirius rose at slightly different points along the eastern horizon, large temples, with long narrow corridors which eliminated most of the interferring light of dawn, were built to focus upon and predict this vital annual occurance.[38]

It seems to be the sun, however, which has left the most decisive celestial imprint upon man over the centuries. It is perceptually dominant due to the magnitude of its radiation and its immediate contributions to the needs of daily life, and possesses a singularly unique potential to penetrate into physical environments, and to thereby enable built articulations of its intrinsic temporal messages. 25

The daily rebirth of the sun was greeted by primitive people with rituals and worship. The sun became a heroic deity which did not suffer periodic death, as did the moon for three days, but rather passed nightly into the lower regions, the kingdom of the dead, returning the next day eternal and unchanging. The east and sunrise became

equated with life and renewal, while the west and sunset were related to death and the end of cycles. Thus, in the medieval basilica and cathedral, the chapel and alter face the rising sun in the east, while the western entrance was filled with messages of the last judgement and apocalypse. Widespread beliefs continue in New Zealand and the New Hebrides, that to merely look at the setting sun can induce death, and the natives of the Hervey Islands believe that groups of the dead gather at sunset in order to follow the declining sun into the lower regions.[39]

While there does not seem to have developed a substantial fear over the daily return of the sun, seasonal patterns of alternate fading and intensification of the sun have evoked incredible efforts to reconcile and maintain its potency. In ancient Egypt, where the religion was more dominated by sun-worship than probably anywhere else, elaborate rituals attempted to rejuvenate the declining sun:

> Ancient Egyptians and Syrians used to hold midnight ceremonies from which they emerged shouting hymns to the waxing of the light; it was the nativity of the sun, and fittingly they bore images of an infant - the newborn sun.[40]

It may be that the 52° slopes of the Egyptian pyramids were devised to reflect sunlight back to the sun at the winter solstice, in order to revivify it when it is at its weakest intensity.[41] At the latitude of the Great Pyramid of Giza, the southerly side of that construction produces a maximum reflection of sunlight at only one day of the year, at noon of the winter solstice, when the sun is at an altitude of 38°. Across the oceans, the giant Mayan pyramid, called El Castillo by the Spaniards, appears to have been dedicated to sun-worship. There are four groups of 91 steps on the sides, which together with the single step to the upper platform, add up to the 365 day total of the solar year. Nearby constructions included a circular observatory for astronomical sightings, and temple for human sacrifice, in which the sacrificial blood was thought to renew the failing energies of the 'dying' sun.[42]

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In many places, winter festivals and feasts have marked the end of the year and the beginning of the new year.

> ...these rites...aim at abolishing the time that composed the cycle now being brought to a close.... By extinguishing all fires, "darkness" is established, the "cosmic night" in which all forms lose their outlines and become confused. At the cosmological level, this "darkness" is identified with chaos, as the rekindling of the fires symbolized creation...[43]

In European festivals, the bowling of flaming wheels down hills at the time of the solstices, was probably an attempt to restore the sun's powers.[44] The war of winter against summer, of darkness against light, is expressed in the January saturnalia of the Iroqois, the ceremonial contests during the Swedish May festivals, the conflict between Ra (who governs the east) and Osiris (the west) in ancient Egypt, the Christian birth of a messiah at the time of the winter solstice, and the ritual of natives on the Banks Islands, who cover megaliths facing the rising sun with red clay, in order to renew the sun's luminance.[45] At Hagia Sophia, brilliant shafts of sunlight move across the interior as the sun passes through the sky; on Christman morning the sun rises at a point directly aligned with the main axis of the building. Related sunlight shafts, suggestive of specific temporal implications, roam the interior spaces of the Pantheon and St. Peters in Rome, and may well have been an intergral liturgical feature in much religious building up to the seventeenth and eighteenth centuries.

The occurance of cyclic celebrations, in addition to their past functions of divine appeasement and didactic event,

performed an ultimately far more important function of providing reference points of real 'body-connected' time within the passing of the day and year, loci of orientation with which to cement together the more fleeting moments between. Similar cyclic events have never been more needed than they are today, within a modern industrial world calibrated by exploitive schedules of economic production and entertainment; the punch-clock, the work-shift, the weekend, the vacation, and the television program.

The natural schedules of our bodies, which are clearly rooted in the rhythms of the earth and cosmos, cannot be continually abused without showing some serious repercussions.

> ...The delicate phasing of hormones that predispose our vitality and our moods becomes entirely desynchronized from other functions when we keep erratic hours, when we cross time zones, rotate shifts, invert day and night....It is one thing when weekly phase shifts shorten the very lives of rodents, but serious when the cumulative effects of phase-shifting begin to cause failing health in middle-aged individuals, and catastrophic when it happens to large populations.[46]

Our health depends upon working with these internal rhythms, rather than against them; synchronizing and

reinforcing them through immersion in their natural parallels, rather than cutting them off from reverberation with their precursors, within artificial schedules and environments. It is not surprising that people who lose track of time often experience panic and disorientation. By contrast, those who have managed to reunite themselves with their ancestral rhythms speak glowingly of a newfound sense of stability and well-being. Certainly, time is as crucial as place in maintaining human orientation.

If we are going to provide moments of 'natural' time celebration and articulation within the pervasive artificial 'floating' time of modern life, we must be able to interject both time-places and time-events, which are directly activated by cyclic natural light, into a range of environmental scales. The temporal light-events of the temple and cathedral, of the new moon and the setting sun, must be reintegrated into a cultural and spiritual context appropriate to the current age.

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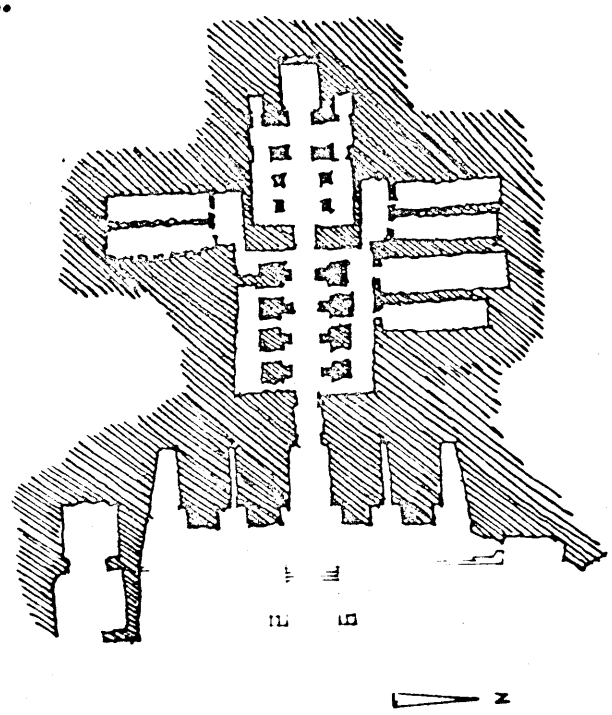

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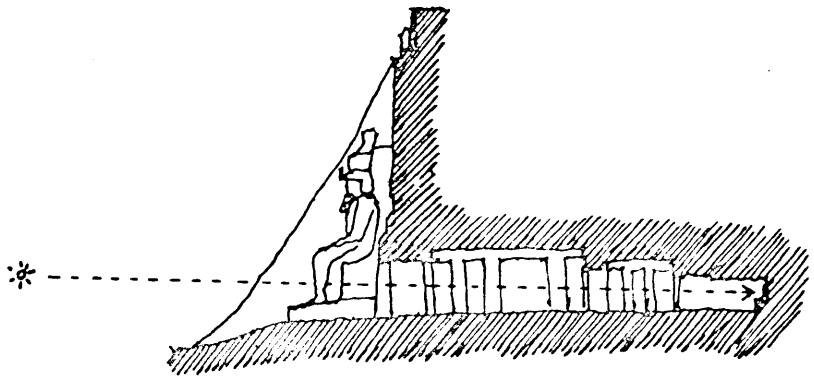

TOMB OF RAMESSES II · ABU SIMBEL

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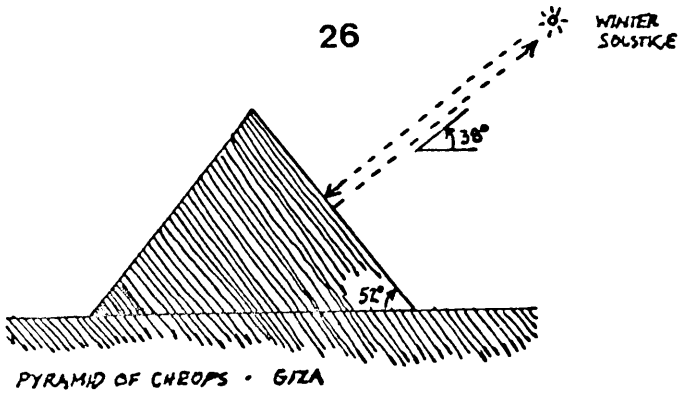
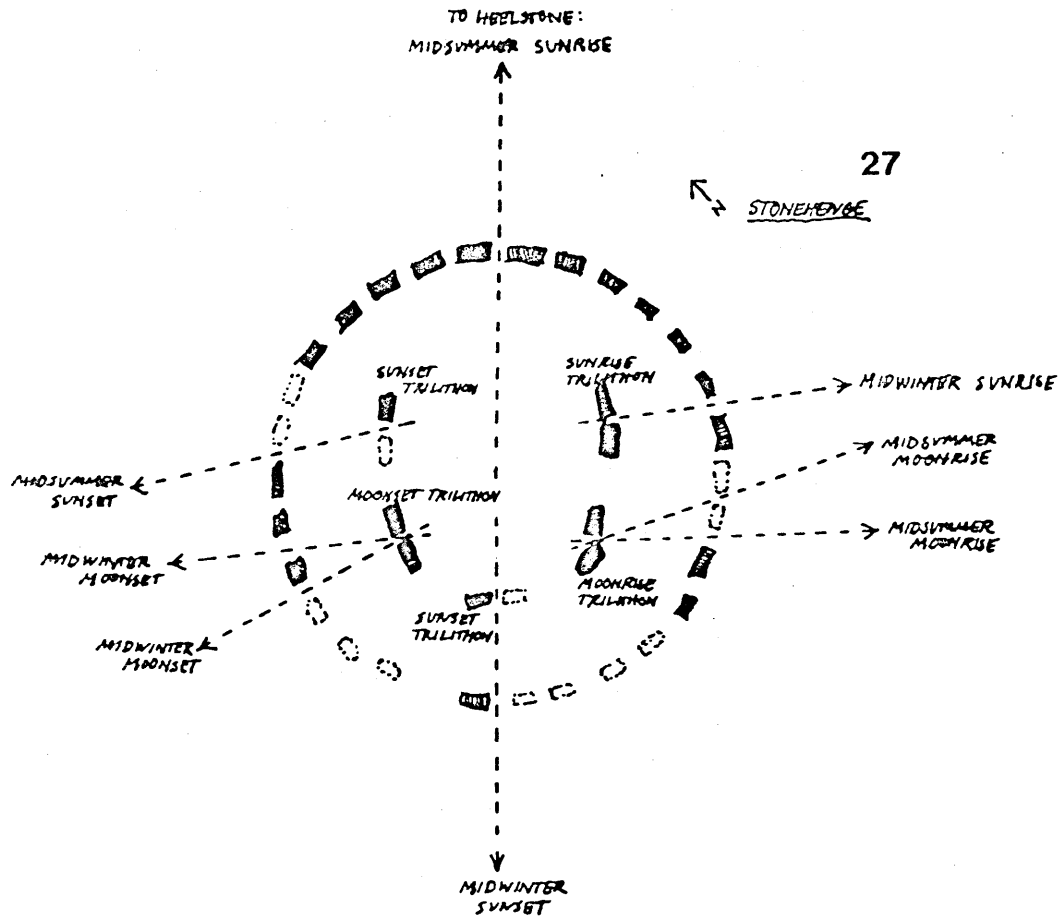


PYRAMID OF CHEOPS · GIZA


TO HEELSTONE:
MIDSUMMER SUNRISE
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STONEHENGE
SUNSET TRILITHON
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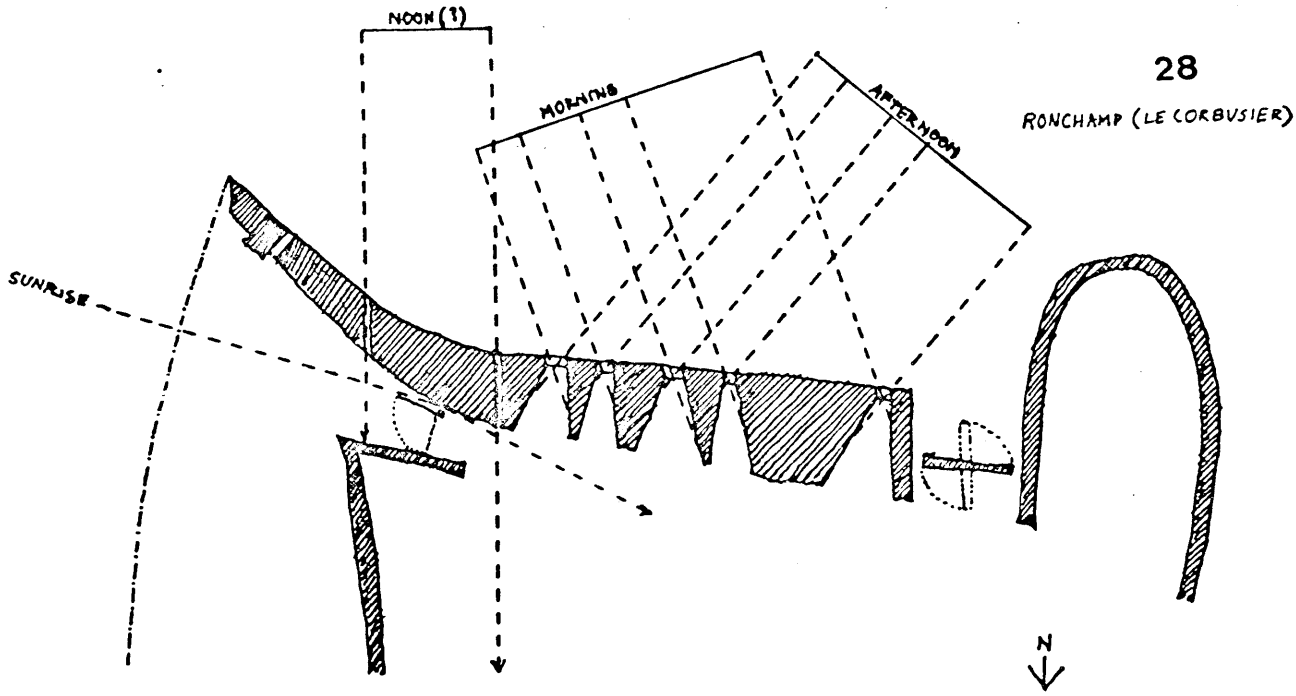
NOON (1)
MORNING
AFTERNOON
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SUNRISE
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4. Privacy/Continuity

Visual privacies and continuities in the physical environment provide us with vital rejuvenating retreats from, and life-sharing connections with, the world outside ourselves. They are probably second in environmental necessity only to the provision of elementary life-sustaining shelter, for they are the source of much of our daily and seasonal schemata of the world which surrounds and sustains us, as well as a means of escape when it has exhausted or threatened us. These environmental qualities and the deeply reverberating associations which they evoke, probably have their origins in primitive man's initial efforts at survival, in seeing and not being seen, but have included as well his taboos

of dress and exposure, attempts to create sacred space within a profane world, his desire to generate visual connections with those aspects of the world he loves, and to isolate from view those qualities which he abhors.

The common built definitions we encounter in daily life: the cellular enclosure, the planar 'focused' picture window, the glazed holes-in-the-wall which provide most of our windows, and the 'glass cage', don't provide us with sufficient options of privacy or continuity. The planar picture window and hole-in-the-wall are simply incompetent definitions, since they are limited in use to the framing of singular views, rather than allowing one to get into a zone of glazing in which there are real options of immersion in, or continuity with, the outside. The cellular enclosure and glass cage, on the other hand, produce singular conditions of nearly complete separation from, or immersion in, the outside, without intermediary choices of being partially in a variety of enclosures. While these definitions may be appropriate to the programs of a warehouse, bomb shelter, submarine, or greenhouse, they don't evolve from or support

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the complex range of activities and place-needs which occur within most habitations.

If physical definitions are to create strong conditions of privacy and continuity, they must form corners, pockets of definition within which one can be immersed along several sides. When glazing generates a corner, a zone is created in which one is surrounded by the outside environment, containing wide-angled views with which to scan and explore its substance. Alternately, corners of privacy produce pockets of security and belonging. It is not accidental that people gravitate toward the bay window, the screened porch, the breakfast niche, or try to place the back of their chairs against a solid protective wall. 11 13 32 50

If physical definitions are going to accomodate and sustain the complexities of life, they must grow from, and provide places for, that same range of complexities. Trees and shrubbery; built ground; continuous surfaces of 2-sided opaque walls and slabs; pitched roofs; partially discontinuous lineal frameworks, platforms, and surface-networks; glazed films of transparency and translucency; and spatial defining furniture, can all be assembled as 40 41 42 14 50 52 53

direct translations of desired privacies and continuities, both inside and out. This would result in the interlocking employment of the major families of privacy definition: 'caves' (masonry walls, concrete), 'trees' (frameworks, screens), 'atmospheres' (films, filters), and 'clearings' (decks, roof gardens).

The first use of visual privacy must have been for protection from enemies, both dangerous animals and hostile members of one's own species. Early caves, walled enclosures, and camouflaged tree houses have found their counterparts in all ages, in the trap-door, the underground escape passage, and the early Christian catacombs. Since the ability of an environmental definition to withstand an 'ultimate' physical force is so closely interconnected psychologically with its capacity for visual privacy, opaque definitions which are to have the capacity of evoking protective associations must either be inaccessible and difficult to reach, as in trees or atop cliffs, or must be strong and durable where vulnerable on the ground.

Definitions which evoke the strongest sense of protective privacy are extensions of built-ground, usually of solid masonry such as stone, concrete, or brick; these conditions were brought to their defensive extreme in the Norman Keep, the Mycenaean fortress, and the Renaissance palazzo. One reason the modern flimsy opacities cannot associatively replace the privacy qualities of these sturdier materials, is that one knows they are barriers only to vision. Places in which insubstantial definitions form the only zones of privacy, such as occurs in the framework plus thin infill assemblages of much modern architecture, evoke associations of instability and transience. While this may be a positive quality within cultures of renewal, as have evolved in Japan, where continuity and stability are manifested within the cyclic processes themselves, their dominance in the pervading uncertainties of modern industrial life provide painful insult to our desperate need for occasional places of stable enduring reference. Frank Lloyd Wright knew well of the necessity for protective privacy definitions; his houses grew from massive masonry walls and fireplaces, which provided something secure to 'hold on to' and be within.

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Visual continuities are equally necessary conditions for environmental protection. Visual contact with the outside world is essential for anticipating events to come, for the recognition of enemies, potential danger to one's kindred, approaching natural catastrophes, etc. The earlist zones of heightened visual continuity were probably watchtowers and look-out posts; high in the tops of trees or the peaks of hills, one could have visual contact over great distances, and thus foresee, plan, or forestall potential confrontations. More recent analogues include the crow's nest, the projecting cylindrical corner of a castle, the observation balloon, a 'peep-hole' on one's front door, and the periscope of a submarine. A less extreme version occurs within Herman Hertzberger's Montessori School in Delft; interior windows between classroom and hall allow teacher and student to retain some mutual visual contact while the latter play in the less protective region immediately outside the classroom. Continuities of anticipation occur in the episodic street sequences of Venice and Rome, where events such as a projecting church facade, or a framed view of an obelisk are previewed some distance away in order to provide nodes

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of orientation and clear options for movement.

Daily public life, with its pervasive external demands for particular modes of behavior and conformity of dress, evokes a strong counter need for private places in which freedom of action can occur, temporarily free of external restraints of criticism. These needs often heighten when people are involved in some kind of personal work, in which they want to be free of judgement, or even 'theft' of seminal ideas, until it is in some way finished. This aversion to having someone 'looking over your shoulder' is particularly acute among 'artists', and in the ritualistic unveiling of their work.

Privacies can also be intimately tied to the need for territorial possession of both place and objects. Since viaual contact is an act of ownership in some ways, itself, then territorality can be achieved through visual separation as well as the usual bounderies and markers of ownership. If you interact with something visually, it is yours for a brief moment; in the same way, ultimate

possession occurs by entirely removing its visual access from other eyes. The private collection of paintings, the Mid-Eastern custom of a woman hiding her face behind a veil when in public, and the Catholic rituals of hiding and occasional celebratory display of sacred relics, are manifestations of the potency of privacy as an act of possession.

When aspects of the private environment are opened up and shared with the public world, a convivial atmosphere is created. Sometimes this occurs simply by a sharing of physical definition, as when the Florentine Palazzo Medici-Riccardi provides public stone benches at the base of its walls, or in the nightly spreading of light onto the public urban street by shops, theaters, and restaurants. The atmosphere becomes festive when there is an actual sharing of activities; our occasional public parades, street musicians, fireworks, Christmas caroling, and puppet shows, are rather minimal signs of the potential civic pleasures possible when otherwise private people are willing to collectively contribute some of their private life to the public region.

> Anything so gay, so bright, and lively as the whole scene there, would be difficult to imagine. From all the innumerable balconies: from the remotest and highest, no less than from the lowest and nearest: hangings of bright red, bright green, bright blue, white and gold, were fluttering in the brilliant sunlight. From windows, and from parapets, and the tops of houses, streamers of the richest colors, and draperies of the gaudiest and most sparkling hues, were floating out upon the street. The buildings seemed to have been literally turned inside out, and to have all their gaity toward the highway. Shop fronts were taken down, and windows filled with company, like boxes at a shining theater; doors were carried off their hinges, and long tapestried groves, hung with garlands of flowers and evergreens, displayed within... [47]
>
> Charles Dickens:
> 'Pictures from Italy'

Some privacies and continuities are concerned with degrees of exhibition and display: of portions of anatomy, of status or achievement, of certain acts, or of merchandise, all of which vary considerably between cultures. Elimination, bathing, the changing of clothes, and sexual intimacy, find physical accomodation in the water closet, bathroom, changing room, bedroom, woods, etc., where either physical definition or isolation from others provides the necessary psychological privacies. One might expect the degree of this kind of physical privacy to vary directly with

densities and adjacencies of people, although the thin air-porous screens which have necessarily evolved as privacy definitions in hot-humid climates, as with the Japanese shoji screens and the royal Zambian enclosures of woven matting, seem to suffice where there is a culture of modesty and restraint to respect their limitations.

While the covering of sexual anatomy is a commonly experienced analogue to built descreet privacies, the low-cut dress and the display of military ribbons provide parallels to environmental exhibitionist continuities, where attributes are intentionally displayed for viewing and 'selling.'

Entire buildings of exhibition occur in galleries and stores, and reached immense sizes in the great international and industrial exhibitions of the nineteenth century (the Crystal Palace, Hall of Machines) and the European market halls (the Halles Centrales in Paris, the Galleria in Milan). Smaller-sized glass enclosed displays, either protruding out into the pedestrian street or concavely

recessed from it, are common attempts to gain the attention of pedestrians within the flow of sidewalk traffic. While the former sticks itself out into one's face and path of movement, the latter invites you into its own territorial pocket of space. Both forms have analogues in the sideshow of an amusement park, the side chapels within a Roman Baroque church, a Roman obelisk which deflects street traffic, the display of objects within a museum, and traffic lights overhead. The elaborate glazed shop windows built in Germany in the 1920's, are a recent peak of interest in the commercial potential of this type of visual continuity; the even more recent Design Research building in Cambridge, Mass., functions as a large multi-leveled display window seductively oriented to the passing shoppers.

Presentational continuities which emphasize objects or phenomena by either a dramatic or sensuous spotlighting are perhaps the strongest and most persuasive means of display, for they rivet one's attention with their perceptual domination and effective obliteration of potentially competitive surroundings. This happens

occasionally during the day; the sighting down a dark cavernous nave of a medieval church to a terminal chapel flooded with light, or the restricted view of a distant luminous piazza through narrow, dark streets in Rome. 18 The most frequent examples are generated with artificial lights at night, or within dark enclosed spaces: the cinema, the theatrical stage, the neon sign, the door light, the illuminated display window, etc. The Science Museum in Boston is an example of a large scale orchestration of these qualities; within relatively dark spaces of many sizes, are dramatically illuminated exhibits and objects which appear below, hovering laterally at eye level, or floating overhead according to changing locations of reference. Far more spectacular are the light attractions of the city in the darkness of night: the amusement park and carnival, the Las Vegas strip, and the glittering canyon of Times Square.

In contrast to more sophisticated displays, it is a pleasure to encounter places where items are presented unadorned, on their own merits. In the open-air markets of Europe and the Orient, used book stores, junk stores, old churches, the traditional hardware store, and the older

of which provided a separation from the secular world by simple physical displacement. Some separations are augmented and articulated by rituals of boundaries.

> The enclosure, wall, or circle of stones surrounding a sacred space...does not only imply and indeed signify the continued presence of a kratophany or hierophany within its bounds; it also serves the purpose of preserving profane man from the danger to which he would expose himself by entering it without due care. The sacred is always dangerous to anyone who comes into contact with it unprepared, without having gone through the "gestures of approach" that every religious act demands. "Come not nigh higher," said the Lord to Moses, "put off the shoes from thy feet: for the place whereon thou standest is holy ground." Hence the innumerable rites and prescriptions (bare feet, and so on) relative to entering the temple, of which we have plentiful evidence among the Semites and other Mediteranean peoples. The ritual importance of the thresholds of temples and houses is also due to this same separating function of limits... The same is the case with city walls: long before they were military erections, they were a magic defense, for they marked out from the midst of a chaotic space, peopled with demons and phantoms, an enclosure, a place that was organized, made cosmic, in other words, provided with a "center" That is why in times of crisis (like a siege or an epidemic), the whole population would gather to go round the city walls in procession and thus reinforce their magico-religious quality of limits and ramparts. The procession, with all its apparatus of relics and candles, was sometimes purely magico-symbolic in form: the patron saint of the town was offered a coiled waxen taper as long as the perimeter of the wall....In northern India....in time of epidemic, a circle is described around the village to stop the demons of the illness from entering its enclosure. The "magic circle",

> in such favor in so many magico-religious rituals is intended to set up a partition between the two areas of different kinds.[48]

Physical separations which seek to eliminate from visual contact those aspects of the environmrnt which one dislikes or detests, occur often in the city, as people try desparately to escape the harshness outside by building internal atriums and courts. Even several thousand years ago, in the Roman city of Pompeii, the dwellings 39
consistantly turned their backs on the street to form open private regions within. In modern building there appears to be a passionate effort to hide clothes, wiring, plumbing, toys, collections of all kinds, and all the other assorted signs of life. We have elaborate 'hiding' facilities for these items: closets, cabinets, stud walls, basements, and attics.

While privacies generally play a supportive role, keeping undesirable conditions away in order to allow other activities to occur without irritation or interference, continuities may directly extend and enlarge one's perceptions of the ever-changing kinetic conditions of

museums, before hard-selling embalming techniques of presentation transform them, as they have other places, into hermetic over-packaged display counters, one can still enter a world where the continuities are catalysed by the qualities, accessibility, and attraction of the stuff itself, piled up in quantities, varieties, and spatial juxtapositions which make an exploratory event out of picking and choosing potential interactions.

Visual separations are often generated to place oneself in a completely different world from that which is surrounding one; these range from the temporary exclusion of distractions, as when one is writing, thinking, studying, meditating, etc., to the need to create sacred spaces far removed from the profane world outside. The medieval cathedral builders provided highly convincing separations 38
from the busy streets outside with thick stone enclosures, whose only windows were placed so high above eye level that the light they admitted carried solely the non-secular information of the luminous celestial vault. The Greek temple was often sited high in the mountains, at the end of a promontory, or as in Athens, upon an acropolis, all

life, opening up and making accessible new worlds of reality.

An immediate direct benefit of connections with the outside world is the wealth of information made available. A man eating dinner alone can watch a tennis match below him, and a child can look down from his bedroom through an interior glass window to see what the rest of the family is doing. One can observe, and therefore learn about and grow to understand, much of the life around him from within the secure partial privacies of a building. This information can serve to generally educate, and in a more specific sense, to provide invaluable schemata of conditions in the outside world from which to make decisions and take actions. Phenomena which can be made available through continuities include: other people working, playing, walking, loving, eating, talking, sporting, trees blowing in the wind and growing over the years, leaves changing color, clouds racing across the sky, snow falling gently upon rocks, rain falling in white streaking forms from the sky, creating sheets of flowing water which transform the world around into

one continuous faceted mirror, the pageantry of light and color in the sky above, the cyclic movements of the sun and moon, and the lights of distant worlds rotating through the night sky.

In addition to providing us with knowledge of our environment, connections with the outside world can create a sense of collective and mutually nourishing existance with nature and other people. On a psychological level, they provide a continual stream of evidence that we are not alone or alienated, that we are surrounded by lives and natural processes which are closely interlocked with our own, and in which we can find some degree of companionship and support.

A by-product of securities discovered through connections with the outer world, is manifested in one's being able to carry on private or semi-private activities, while retaining contacts with other life. Many people can be encouraged and sustained in exerting themselves on an essentially private task or working condition by occassional indirect contacts with the activities of

other life, even if at a distance. Private existance requires some kind of public sustinence, either through other people or nature. Exertions of private concentration are temporary periods of social estrangement, and it is not surprising that a 'social animal' such as man needs some kind of 'social energy' repeatedly channeled back in, in order to sustain it.

The presence of environmental connections, which could provide the relatively immediate benefits of extending information and awareness of the world around us, and supplying a continual reinforcement of a collective reality, might also initiate more humane collective attitudes toward the rest of the world, both of people and nature. A built environment which provided connections between man and the whole of life, which is interlocked and woven with the sun (as at Stonehenge), with the stars (as a Jaipur), with the moon (as from a Tsukimidai), with the changing seasons and landscapes of rocks, plants, and sand (as at Katsura), with the sky (as at the Villa Savoye), with water (as at Falling Water), with people inside (as at Charreau's Dalscace House), and with people

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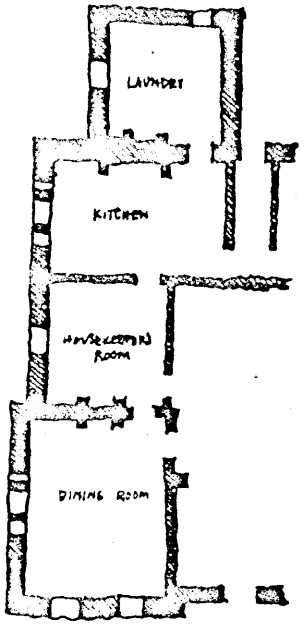
52

outside (as on hill towns in the Aegean), which becomes 42
a set of definitions which initiates and supports interchanges between man and environment, might be able to contribute to the humanizing of the individual: to his awareness and understanding of who/what/where he is and of his mutually dependant inter-connectedness with the rest of life.



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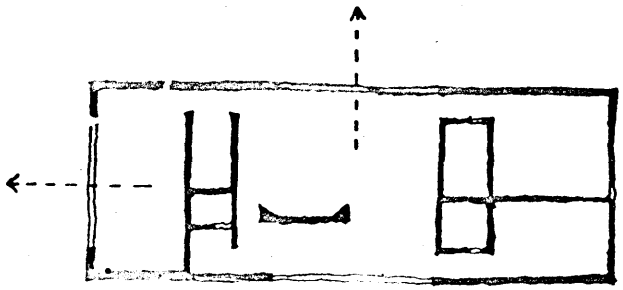
KING HOUSE · NEWPORT (RICHARD VPJOHN)



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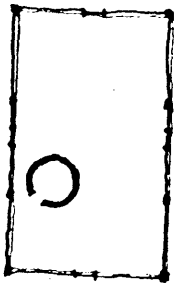
ONETO HOUSE (PHILIP JOHNSON)



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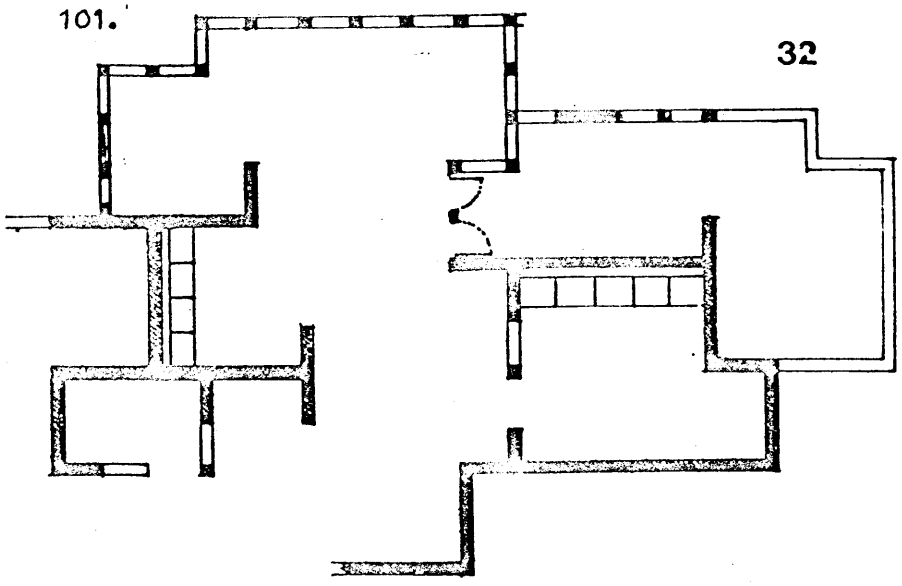
JOHNSON HOUSE (PHILIP JOHNSON)

32



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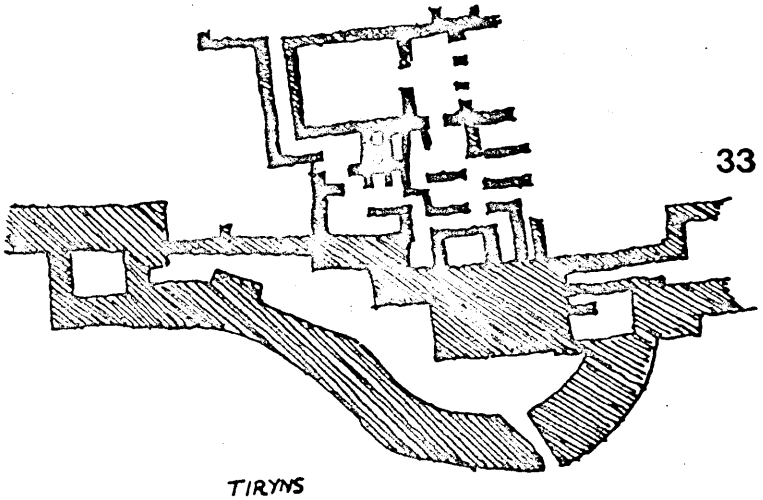

TIRYNS

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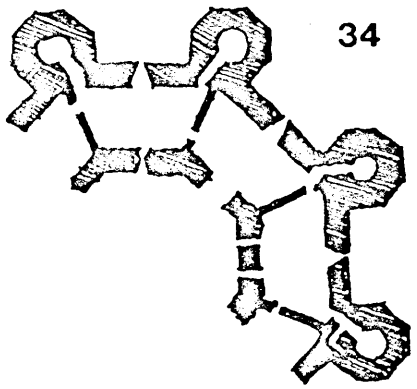
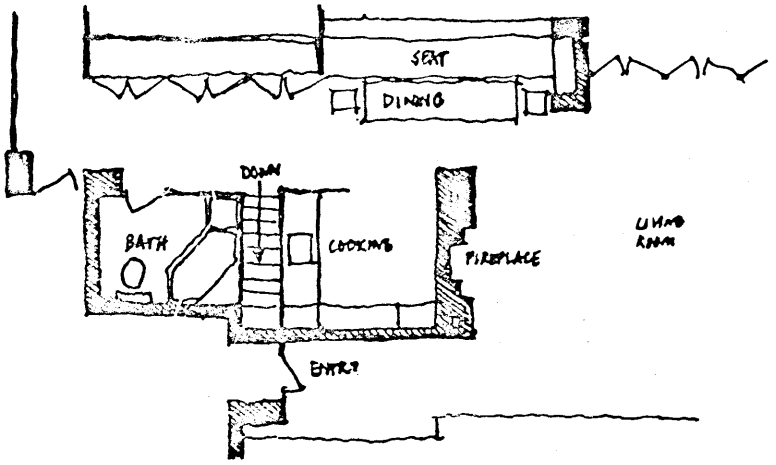


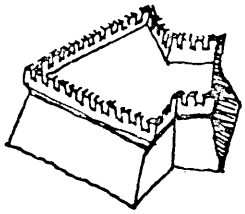
CASTEL DEL MONTE

35



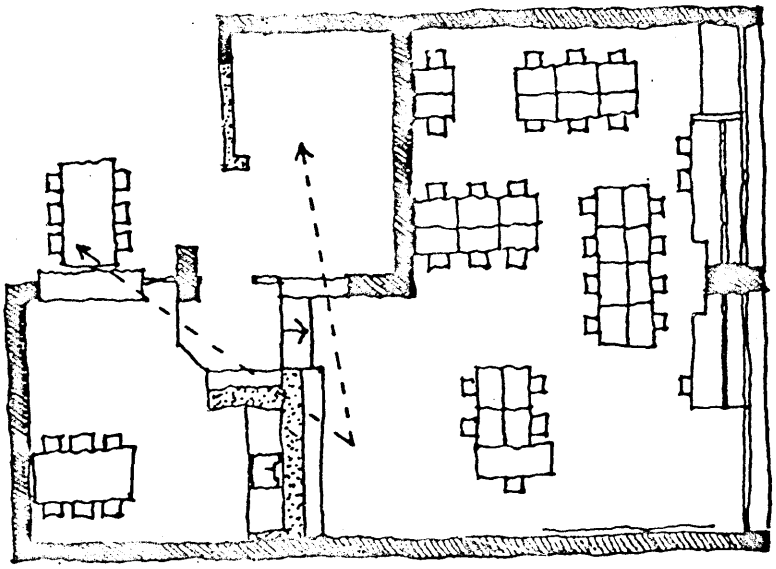
JACOBS HOUSE · MADISON (FRANK LLOYD WRIGHT)

36



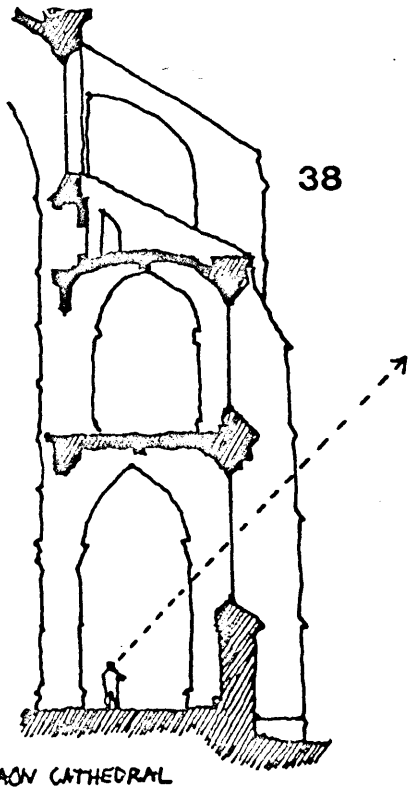
WEDGE-SHAPED BASTION
(FRANCESCO DI GIORGIO)

37



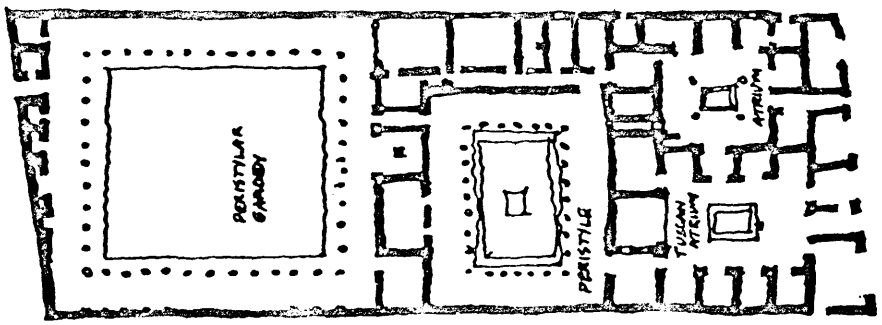
MONTESSORI SCHOOL · DELFT (HERMAN HERTZBERGER)

38



LAON CATHEDRAL

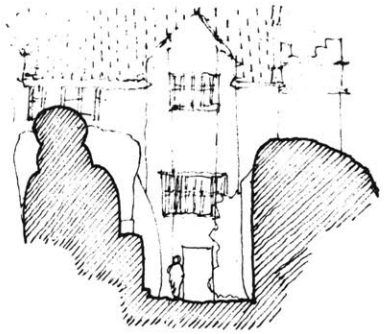
39



HOUSE OF THE FAUN · POMPEII

PARTIAL ILLUSTRATIVE VOCABULARY OF BUILT PRIVACIES/CONTINUITIES

40



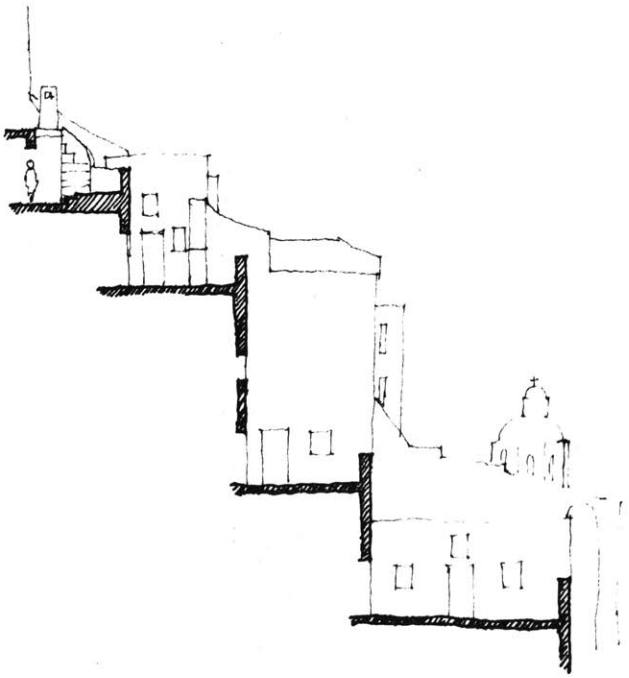
TOPIARY • LEVENS HALL
WESTMORLAND, ENGLAND

Plants
screens
ledge definition
privacy pockets

41

PIAZZA DEL POPOLO • ROME (VALADIER)

Ground Form
level changes
ledge definition



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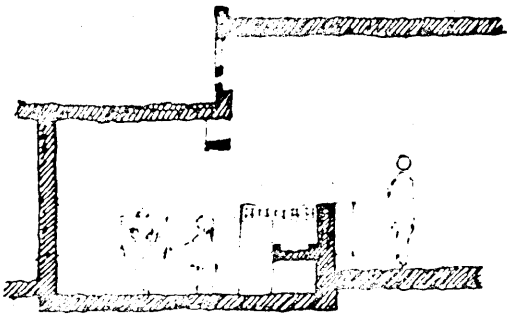
SANTORINI • GREECE

2-Sided Walls/Slabs
privacy pockets
galleries
roof decks



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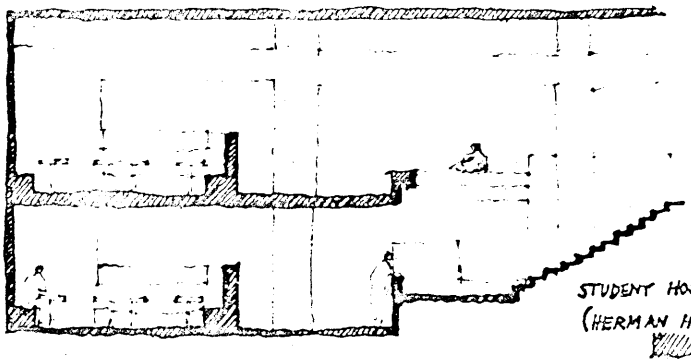
MONTESSORI SCHOOL • DELFT
(HERMAN HERTZBERGER)



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STUDENT HOSTEL • AMSTERDAM
(HERMAN HERTZBERGER)

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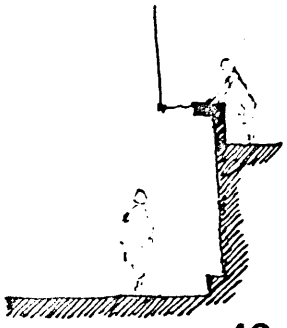

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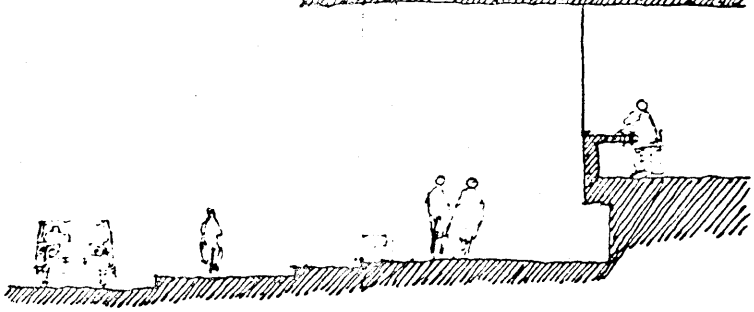
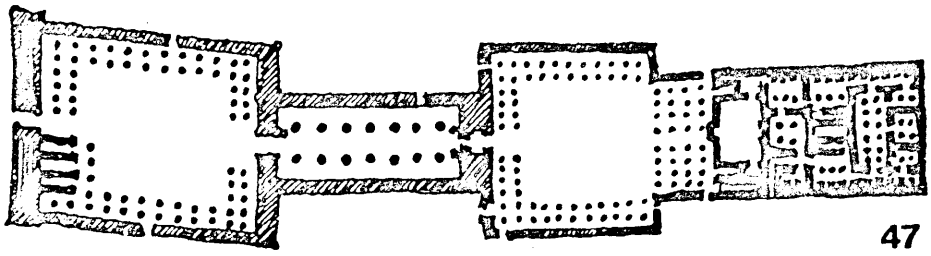


2-Sided Walls/Slabs . . . . . level changes
level changes
ledge definition
level changes
ledge definition
gallery
privacy pockets
level changes
ledge definition

TEMPLE OF AMEN-MUT- KHONSU • LUXOR



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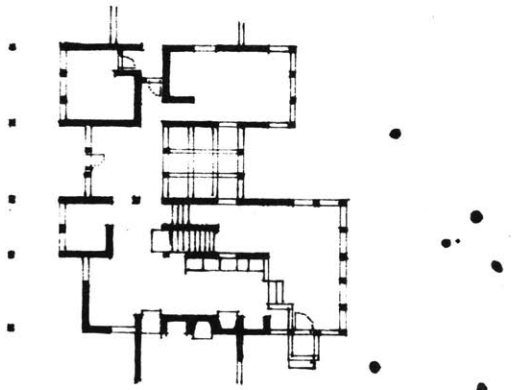
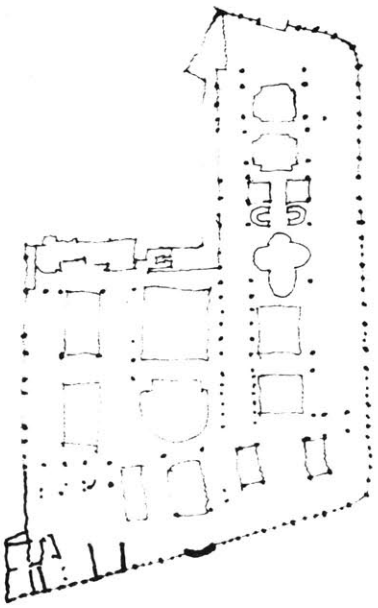
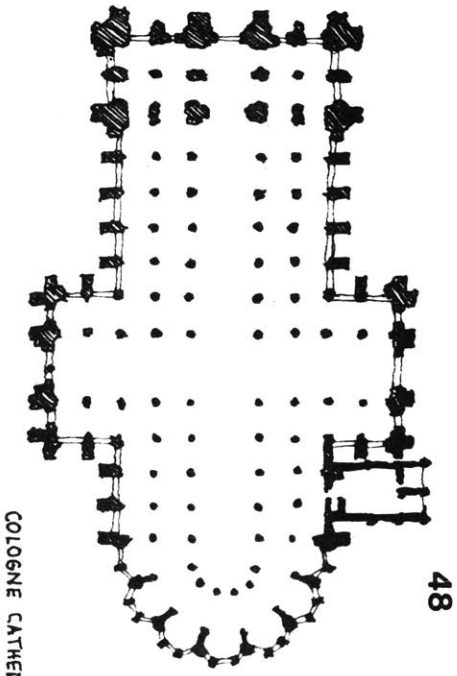
Frameworks . . . . . partial continuities



50 GROTON HOUSE (MAURICE SMITH)



49 BON MARCHÉ • PARIS (EIFFEL AND BOILEAU)



48 COLOGNE CATHEDRAL

Partial Infill of Framework — clear glazing/opaque panels — continuity pockets

Partial Infill of Framework — clear glazing — partial continuities

Partial Infill of Framework — stained glass — partial continuities

51

JAPANESE HOUSE • ATAMI

52

DALSACE HOUSE • PARIS (CHARREAU)

53

Partial Infill of Framework ..... clear glass/diffusing glass
Partial Infill of Framework ..... metal screens/opaque plaster
Furniture ..... storage cabinets
Partial Infill of Framework ..... diffusing paper
wood/bamboo screens
opaque plaster
light-filled privacies

5. Heat

Our patterns of heat and cold on earth are synchronized by the rotation of the earth around its axis, creating the periodicities of day and night, heat and cold, activity and repose of natural life, and additionally by the tilted revolution of the earth around the sun, generating the rhythms of the seasons. The earthly accumulation of solar heat results from several physical processes: first, a stream of photons from the sun possesses kinetic energy, which manifests itself as heat when the photons are stopped in a piece of matter; secondly, emissions of solar energy include a variety of wavelengths, including infrared as well as visible

light.

The sun's photosphere radiates about $5x10^{23}$ horsepower into space per minute, two-billionths of which are received by the earth, 93 million miles away. The amount of energy radiated at each wavelength depends upon the temperature of the sun's photosphere, which is approximately 6000°K. At this temperature, those particular wavelengths of electromagnetic energy for which the radiation is strongest lie in the blue region of the visible portion of the spectrum. The sun doesn't appear this color since the earth's atmosphere scatters the shorter wavelengths of blue light better than any other color in the visible portion of the spectrum, and thus the light coming through unscattered must appear less blue. Also, even though the peak of the energy curve which describes the relative amounts of emission in various wavelengths is in the blue, the sun still radiates much warmer colored light; greens, yellows, oranges, and reds, which combines with the blue to produce a near-white.[49]

An additional consequence of this tendency for a broad range of wavelength emissions, is that there are radiations

to some degree of wavelength up and down the electromagnetic scale. Most of the wavelengths shorter than visible light are absorbed by the earth's atmosphere. The limit is 0.00003 cm; no radiation of shorter wavelength reaches us on the surface of the earth. The absorbtion of this radiation heats the atmosphere, so that at heights of 100 miles or more above the earth's surface, the air is much hotter than it is at the surface itself.

Those wavelenghts reaching us which are slightly longer than visible light, infrared rays, are too long to be detected by the eye, and are rather experienced as heat. The simultaneous presence of these rays with sunlight, and especially the production of heat when light is absorbed by materials, creates vital psychological and physical connections between the two, and suggests our inclusion of solar heat as a family of light associations.

We all sense that the heat of sunlight is the source of life itself. When the sun is on the wane, during the lengthening nights and cooling days of autumn and winter, life slows down and often comes to a standstill; as days begin to lengthen and grow warmer in spring and summer,

it reawakens and periods of mating, growth, and fl.wering resume. Yet the strength of our physical and emotional associations with solar heat are not entirely explained by this conceptual panorama.

Probably our most cruical, if less sensuous, associations with the heat of the sun derive from its central importance in our maintenance of thermal balance, the fundamental condition of survival, which depends upon a dissipation of body heat equivalent to the rate of its production. If these rates are uneven, if the rate of heat loss is either too slow (when we become hot) or too fast (when we feel cold), the body passes through a predictable sequence of response from comfort, to discomfort, distress, and failure. Our associations with solar heat should vary significantly then with different climates and seasons. The environmental temperature range which appears to be most sympathetic with our maintenance of a constant interior temperature of 98.6°F. is generally from 65-75°;[50] one might expect climates colder than this to evoke much stronger associations with solar heat, and in those that are much hotter, to show it to a lesser degree. Whether this is so or not is certainly not revealed in any

coherent regional variations of solar worship,[51] though one can probably make a vital distinction between fearful religious associations of impending solar death or abandonment, and secular associations with its intrinsic sensory qualities. It would be interesting to know whether the citizen of India or Morocco has developed a cultural and climatic aversion to the sensory qualities of solar radiation, or whether the resident of Iceland or Siberia feels unusual passion for it.

I would guess that there is a much deeper association with solar heat, which transcends climatic variations, smooths out latitudinal differences in solar attraction even it they do occur, is present as well in the desert and jungle, among the sunbathing snake and opossum, and most dramatically in the mass migrations of humans to southern beaches to bathe in reflective ovens of solar light and heat. Our obsessive body and emotional associations with the intrinsic qualities of the sun's heat, may be linked to our first region of enveloping warmth, the maternal womb, before being thrust out into a cold environment of heat draining air currents and discontinuous maternal warmth.

Whether there is a vestigal imprint of our first environment or not, there is certainly a universal delight, and something immensely healing, relaxing, sensual, almost inebriating, in being immersed in a flood of sunlight. In the gift of a natural sun fountain, on a blazing radiant summer day, one floats in an intoxicating pool of warm radiation, submerged in pulsating waves of sensuous heat. This hot fluidic substance penetrates deeply the sensitive outer membranes of skin, eyes, and lungs, warming and soothing their inner tissues, filling the nose with thick smells of sun baked brick, stone, wood, asphalt, human perspiration, and the delicately saturated odors of grass, bubbling mountain streams, and lilac.

Physical environments which orchestrate these thermal qualities to provide options of warmth and coolness, become thermal fountains. The cool dark interior of a medieval stone church, underground passages and street arcades with their rhythms of hot and cold, the heat absorptive bricks of a subway entrance, which become prized sitting locations in the afternoon of a cool autumn day, the highly reflective surfaces and filters of the beach: the blue sky, glassy surfaces of water,

hills of white and dark sand, and the cool water vapor which fills the otherwise hot air at the Villa D'Este. Despite our persistant attraction to the sun's radiation, for we seem clearly to crave its shower of heat, it becomes rather dangerous in large doses. Our immersion in large quantities of it must be countered with options of retreat under canopies and arcades, and the cooler interiors of masonry buildings.

While we may wish to provide occasional zones of intensified heat and cold within a more extensive built environment, with which to temporarily alleviate the dominant heat of summer or cold or winter, the most pressing need is to generate relatively homeostatic thermal environments. The impending depletion of many of our accessible natural resources requires our reemployment of architectural languages which grow from the cycles of the sun, which can provide habitable internal environments with built configurations and materials that control and condition the shifting thermal stresses outside with a minimum of artificial energy inputs.

In a similar way to natural light distribution, the following of some loose rules of building assemblage can enable the ecologically responsible distribution of solar heat.

1. Growth Form

Optimum orientation for a given site and climate would reduce heat gain to a minimum in the overheated period, while simultaneously giving maximum radiation reception in the underheated period. For a building in the temperate region, this ranges from due south to about 17° east of south, depending on its form.[52]

Optimum shape is determined by which configuration loses the minimum amount of outgoing Btu in winter and accepts the least amount of incoming Btu in summer. This results for all climates in a shape elongated on the east-west axis.[53] Overall massing should vary greatly between climates. Both cold and hot-arid regions possess such excessive adverse thermal impacts, that it is important to build up a volume effect by massing. By grouping what might otherwise be separate building units into one large mass, the overall surface exposed is greatly decreased. In hot-climates, the need is for the opposite to occur. Freely elongated, separated units are necessary to facilitate air movement. In temperate climates, where there is the least stress from any specific direction, the greatest freedom in form occurs. On the other hand, the

presence of both cold and hot seasonal conditions requires a great deal of ingenuity by a builder who wishes to approach optimum conditions for both extremes.

In temperate climates, the north edge should be of minimum surface to reduce heat loss, while the south edge can become quite active and open, in order to provide auxiliary heat from solar penetration in the winter.[54] In hot-arid regions the enclosure should close down along the outside edge, but open up on the inside as a sheltered atrium, producing a new internal edge; cold climates require a closed inactive form on all sides; growth forms in hot-humid climates must remain very open, particularly to the north and south, with an infill of air-porous screens for ventilation.

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2. Roofs

In the tropics, where the greatest environmental stresses are the heat from the sun overhead, precipitation, and the need for substantial air circulation, the roof becomes the primary architectural element, and is generally diagonal to shed the large quantities of rain which fall on it. Similar low-pitched roofs should occur in cold climates

in order to collect insulating snow; in both cold and hot-humid climates, where there is little reason to have access to the roof region, it becomes a 'hat' of pitched surfaces, protecting the habitable regions below.

In hot-arid climates, the roof must be partially discontinuous to permit openings for air vents and atriums. Since there is little precipitation, and the roofscape is a valuable sleeping region on hot nights, roofs would generally be horizontal and accessible.

Temperate climates provide the most diverse environmental conditions through the seasons, and should therefore evoke the most complex roofscapes. Winter snowstorms, substantial rain throughout the year, and hot summers, suggest combinations of some high-pitched, more frequent low-pitched, and occasional highly accessible horizontal roofs. One of the richest such assemblages of varied roof qualities occurs atop the French chateau at Chambord.

55

3. Glazing

One would expect little glass in hot climates, unless it

can be opened for air circulation; in cold climates there would be little exterior glass due to its high rate of heat loss. In temperate climates, glazing should be used freely along the south edge, where the low rays of the winter sun will be allowed to penetrate; a simple overhang prevents summer sun penetration.[55] Some clear membranes along the east edge will help to relieve morning coolness. Openings of any kind along the north edge should be minimized, especially those filled with clear glass, since there is no solar penetration to make up for the heat loss.

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4. Screens

The use of partially discontinuous screens to dampen sunlight penetration is extremely useful in hot-arid climates. A loose sun roof which is separated from the rain roof can intercept and defuse the sun's radiation, as can similar screens detached from the walls.

In temperate climates, solar screens are most useful for shading along the east and west sides; since this is a seasonal need, the ideal screens are deciduous trees which provide the necessary protection in summer, but allow solar

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penetration during the cold winter.

5. Materials/Surfaces

Materials employed along the exterior edge in fixed positions can be chosen and placed where they will be most beneficial for solar conditioning. This would produce an exterior edge which, by thermal damping and distribution, would balance the external heat impacts of various exposures.

The selective absorptivity of both solar and thermal radiation by materials helps control heat impacts. Since solar radiation contains wavelengths which are concentrated near the visible region of the spectrum, color values have a decisive effect on reflectivity and absorption. Percentages of solar reflection range from over 90% for polished silver and 71% for a white painted surface, to only 3% for a black matte surface.[56] Thus in cold regions, absorptive materials are advantageous; in regions where cold and hot periods alternate, the low winter rays of the sun can reach dark absorptive surfaces, while the higher summer rays can be intercepted by reflective surfaces; in hot regions, light colored reflective surfaces are

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beneficial.

The heat transmission characteristics of materials affects both the interference with the passage of heat ('resistance insulation') and the storage of heat ('capacity insulation'). The first is due to the insulation value of the material ('U' factor: Btu/hr/sq.ft.), and tend to be generally lightweight and filled with air, one of the best insulators. Capacity insulation is a function of its volumetric specific heat (density times specific heat), and has the ability to store heat during hot periods and release it at cooler periods. Examples of this process, called a time-lag, are the thick stone walls of old churches and houses, and the mass of earth which surrounds underground chambers: crypts, troglodyte homes, basements, etc.

The employment of materials with these various degrees of insulation should vary drastically with climate. In a temperate climate, massive heat-storing masonry materials should be located on the west side in order to delay the thermal impact of late afternoon; other edges require some resistance insulation to reduce heat loss in cold

periods.

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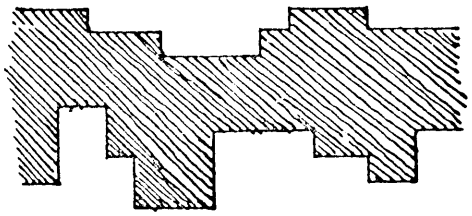

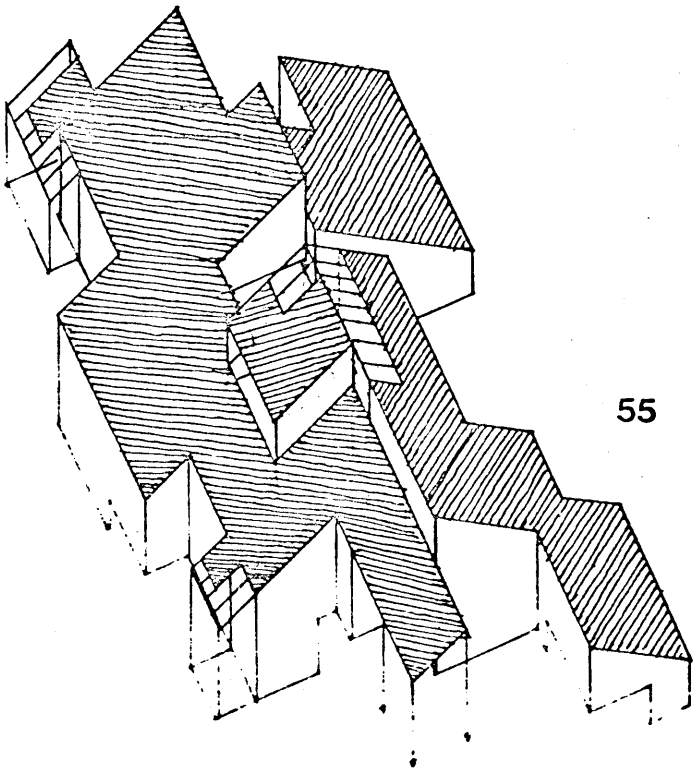

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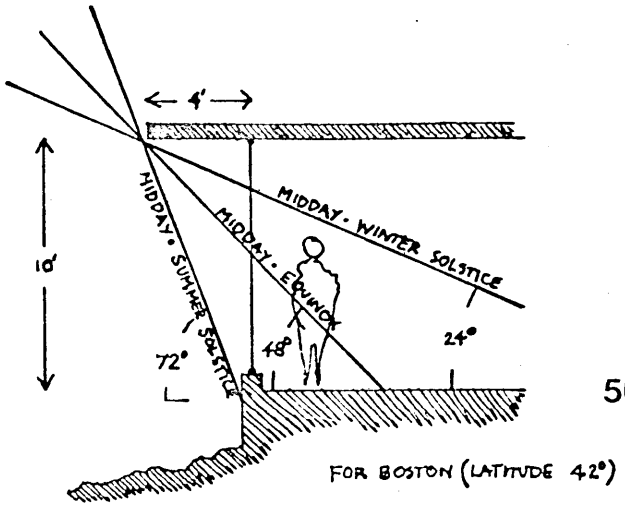

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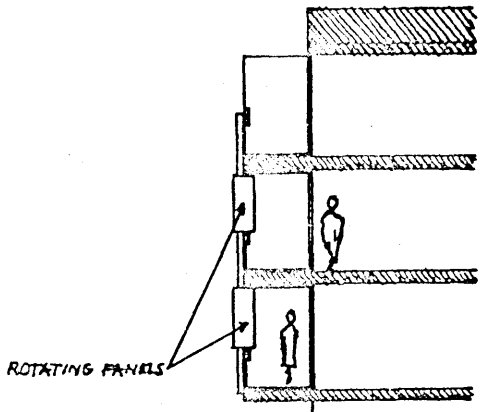
FOR BOSTON (LATITUDE 42°)



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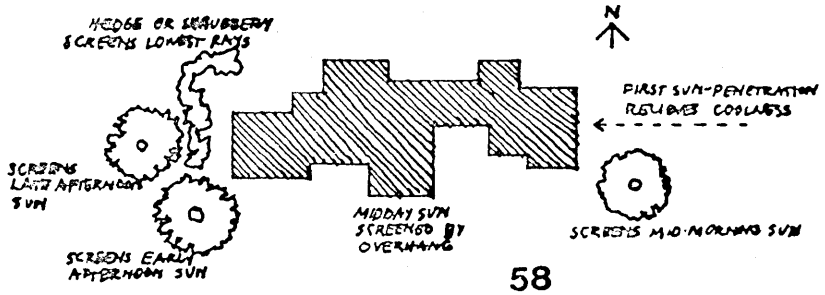
PEABODY TERRACE · CAMBRIDGE (J. L. SERT)



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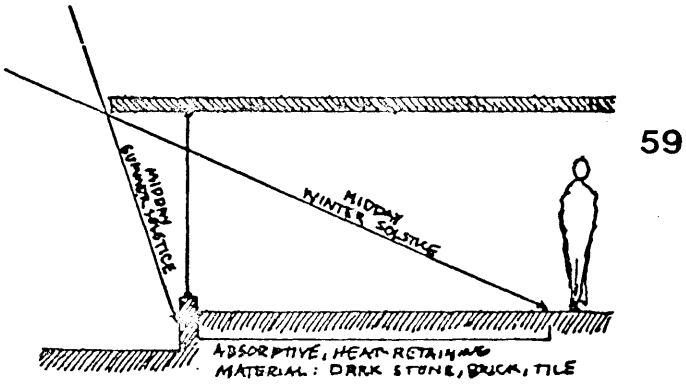

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6. Intrinsic Association

Filtered sunlight trickles down from the canopies, weaving patterns across the pavement, showering sequins upon the milling crowd, igniting women's gauzy shrouds. The lacy trellises of reeds and woven mats glow like so many chandeliers, transforming miles of streets into luminous corridors. There are no harsh shadows; gloom is absent even in the deepest shade. The Moroccans have tamed the sun's fireworks into noiseless fusillades of sparks, beams, and sheafs of light...In the south near the border of the Sahara, where wood and shrubs are scarce, the street arbors are formed by layers of palm leaves that frame pools of sunlight like giant lashes. This is not the hot light that weighs one down like solid matter, but scattered flights of luminous arrows. The most violent streaks of light - little galaxies of suns - are produced by the streets of Marrakesh's suqs which are covered with bands of steel.

Bernard Rudofsky

This subject fascinated but troubled me. I at once saw the making of a picture in it; the great somber door that might open and lead - anywhere; the fortunately placed recumbant figure with the pathos of uplifted folded hands; the lofty window above; all these were fine and right; but to make the whole cohere, speak, escape me. But one day I saw what it must mean - to me at least. As I was studying it the sun burst across it, flooding it with radiance. There is my picture; "Hope" awaiting, an expectancy with a certitude of answer...

Frederick H. Evans
Camera Work, No. 4

Pure sunshine all day. How beautiful a rock is made by leaf shadows! Those of the live oak are particularly clear and distinct, and beyond all art in grace and delicacy, now still as if painted on stone, now gliding softly as if afraid of noise, now dancing, waltzing in swift, merry swirls, or jumping on and off sunny rocks in quick dashes like wave embroidery on seashore cliffs...

John Muir: "My First Summer in the Sierra"

Pillars and arches of emerald green glass above the snow capped summit of a high mountain tower above the sea of clouds....The snow domes in the background are covered with an architecture of glass arches. In the foreground, pyramids of crystal shafts. Above the chasm, a bridge-like trellis of glass....Snowfields in regions of eternal ice and snow - built over and decked with embellishments in the form of planes and blocks of colored glass.

Bruno Taut: "Alpine Architecture"

....And how soft and lovely the light streaming through this living ceiling, revealing the arching branching ribs and veins of the fronds as the framework of countless panes of pale green and yellow plant-glass nicely fitted together - a fairyland created out of the commonest fernstuff.

John Muir

Direct associations with light itself are particularly difficult to 'penetrate' and understand, for they seem to reside and occur at deep visceral levels of response. They have occasionally been articulated by writers: Abbot Suger, St. Bernard, Dante, Henry Adams, John Muir, but these 'private' experiences have never been collected and compared in a way which would 'illuminate' the universal effects which 'families of light' have upon all of us.

The striking quantities and similarities of light associations among various people: the uplifting effects of a sparkling, sunny day, the dreary overcast day, the frightening blackness of the dark, the passion of color-

saturated sunsets, or the delight of dancing water reflections, suggests the possibility of a 'language' by which qualities of light evoke particular intellectual, emotional, and physical experiences. If this language could be translated into an architectural vocabulary, we could begin to again build into our environments the 'luminous food' which man has in past ages found essential to his daily nourishment and sustinance.

The following pages contain the beginnings of an attempt to explore the 'language' of this 'food'. Families of associatively-related light qualities are documented among parallel phenomena in nature, cities, buildings, painting, photography, and literature, conditions of both 'design' and 'accident'. This vocabulary of related light modulations will lead directly to built analogues which can further generate those qualities within a design process.

At the end of this initial, incomplete collection of light qualities, are two projects in which surrogate built-light interventions were generated in urban sites: one an outdoor public arcade, and the other an indoor church lobby.

The intention was to explore the potential and built means for transforming lifeless physical environments, containing acute qualitative deficiencies of natural light, into public and semi-public fountains of sunlight, which provide nourishing sensory moments within an often grim urban experience. Wherever possible, luminous qualities and their physical modulations perform additional roles, such as means of illumination, privacy, time articulation, etc., thus becoming associable at many different levels.

The physically undifferentiated modern city environment reinforces and intensifies the already repetitive and unassociative activities which many people perform during the day, resulting in a kind of 'floating' world, in which one loses contact with surroundings and a consciousness of 'being present'. This ominous quality of modern life seems to be most dramatically relieved by occasional immersions in intensive, highly intrinsic natural phenomena: the 'walk in the woods', the 'breath of fresh air', the 'day at the beach', and the Sunday 'promenade'. These qualities are profusely available in the older cities, particularly in festive Rome, where the humane public environment of showering fountains of water and

onending overlays of rich urban light, color, texture, smell, space, and form, provide significant places of rejuvenation and reaffirmation of existance.

These two projects of surrogate light intervention are attempts at 'growing' some wildflowers, sunsets, and icestorms in the city. One is a light-canopy of stainless-steel which moves in the wind; it is like the branches of an ice-covered tree shimmering in the sun. The other is a forest of glass, running water, and ice, producing three sequential regions of light and color showers, as one moves into a building.

Two Surrogate Interventions

Watching the daybreak and sunrise. The pale rose and purple sky changing to daffodil yellow and white, sunbeams pouring through the passes between the peaks and over the Yosemite domes, making their edges burn; the silver firs in the middle ground catching the glow on their spiry tops...

John Muir

Thus, when out of my delight in the beauty of the house of God - the livelyness of the many-colored gems has called me away from eternal cares, and worthy meditation has induced me to reflect, transferring that which is material to that which is immaterial, on the diversity of the sacred virtues: then it seems to me that I see myself dwelling, as it were, in some strange region of the universe which neither exists entirely in the slime of the earth nor entirely in the purity of Heaven; and that, by the grace of God, I can be transported from this inferior to that higher world in an anagogical manner

Abbot Suger

Fine calm morning; air tense and clear; not the slightest breeze astire; everything shining, like rocks with wet crystals, the plants with dew, each receiving its portion of irised dewdrops and sunshine like living creatures getting their breakfast, their dew manna coming down from the starry sky like swarms of smaller stars. How wondrous fine are the particles in showers of dew, thousands required for a single drop, glowing in the dark silently as the grass!

John Muir

...Frost enough for crystal building, - glorious fields of ice-diamonds destined to last but a night...

John Muir

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