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Beyond Habitat

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Almost every journalist who has interviewed me has asked: "When did you first think of Habitat?"

Most people think of design as styling. You style a building: you *stylize* it. And because styling is related to a single pictorial flash, people think that in the process of design you walk around waiting for that flash to hit you, then you put it down on a paper, and that's how it happens. Ayn Rand's novel *The Fountainhead* romanticized the creation of the moment. In *The Fountainhead* the creative process, if I have to choose one word to describe it, was a *formalizing* process, whereas I feel that design as I experience it, is a *synthesizing* process. The word *design* doesn't exist at all in many languages. In French, *dessiner* is "to draw" rather than "to design." In Hebrew we have *tichnun*, which is "to plan" or *itzuv*, which is "to give form," literally, physically to make form. You make a pot, you shape it with your hand. You are not putting it down on paper to translate it later.

The reason I cannot answer the journalists' question is that I have experienced design as process.

It is easier to talk about the politics of a building and the administrative process of getting it built, of the confrontations, than of the inner workings of the design process. And while it is probably true that for every line drawn a thousand words are spoken and written, and that for every hour spent conceiving a building many hours are spent in the process of realizing it, it is nevertheless also true that in the final analysis most of the energy is spent on conception. Two aspects of this process seem to be significant: one has to do with the formulating of the program of what the building *ought* to be; the other has to do with the genesis of ideas, and the process that leads to what the building actually ends up being.

A moment of genesis for me was the time that I first thought about the idea of identifiable houses floating in space. Almost every project has those moments of realization that have to do with the program and the echoes of this realization in physical images, but it would be an error to think of them as "flashes of inspiration." Le Corbusier gave to one of his most beautiful books the title *Creation is a Patient Search*. These moments are not possible unless they are part of a prolonged process of analysis, of a bombardment of images in response to a search.

But what is even more significant is that these moments in themselves are really quite meaningless. The thought of houses floating in space is only a part of a jigsaw puzzle. That the houses are to be made in a factory and assembled in a particular pattern in space; the geometry in which they interlock; the methods by which they are connected; the system of circulation leading to them – these too are all parts of the puzzle.

Even detailing of the building is part of this inseparable process. Habitat's door-knobs and doors, the way they fit into the wall, light switches and partitions, floors and windows, bathrooms and kitchens, railings and roof-decks, street shelters and elevator cabs, planters and the lighting of the public areas, had all to be conceived in the context of the whole, in the context of the environment they make.

I have found this difficult to talk about because separating so-called conception or design from realization is in itself quite artificial. If there was something unique in the experience of Habitat, it was the way these two were integrated into a single alternating and pulsating process. (It was probably this unity that allowed the building to become a reality.)

How do you talk about it, anyhow? How do you communicate those moments of torture, search, and frustration and those other moments of excitement and fulfilment, orgasmic moments – that kind of growth from blurred images, ideas and thoughts, almost independent images which slowly become clearer and start clicking with each other, and then generating realities you would have never thought of in the first place?

And so I could never answer the journalists' question without taking half an hour to do so. I used to say, "Oh well, you know, it takes a long time, it's the whole evolution of things, you don't think of something in a moment." If I try to answer the question more carefully with reference to Habitat, I must start with some moments in the years when I was a student, when I first saw Le Corbusier's early books and his 1920 sketches of apartment buildings with gardens. Then there was that moment later in my fifth year at university, when I tackled the housing design problem. I had started off drawing townhouses and slabs and then I thought, "I can't do that." And I took a block of wood and cut it up into individual pieces to represent houses. Then I grouped them, not thinking of them as a building but as houses, in a simple checkerboard pattern.

There must be places and towns and houses and gardens that I don't even remember now that helped form Habitat. One of the most powerful images in my childhood was of the hanging gardens of Babylon. For me, they were the Garden of Eden and I had many fantasies about them. The fact that no one knew how they looked, that they were a mystery, that there were no drawings of them whatsoever, made them even more attractive to me. I'm sure those childhood fantasies have something to do with my feelings about the city that are expressed in Habitat.

The corollary of *synthesis* is *process*. In my thesis the simple idea of a house and a garden began to have a physical being, a spiral formation with the mechanical services and circulation penetrating it, houses grouped like a tent enclosing a public space, and all the engineering logistics of a membrane that supports itself in gravity.

Another very important period in my life was that year I spent in Philadelphia. I had much more time to myself. I had acquired new friends, and this was a time when a lot of more or less floating ideas about design were articulated, were tied into a more workable mosaic of ideas, almost a theory. An attitude, anyway.

In Philadelphia Anne Tyng introduced me to a book she called her bible, D'Arcy Thompson's *On Growth and Form*, the great classical work of the turn of the century about the science of morphology. I consumed it. It was through D'Arcy Thompson that I started understanding the nature of form.

Thompson talks about the shell:

"In the growth of a shell, we can conceive no simpler law than this, namely, that it shall widen and lengthen in the same unvarying proportions: and this simplest of laws is that which Nature tends to follow: The shell, like the creature within it, grows in size but does not change its shape; and the existence of this constant relativity of growth, or constant similarity of form, is of the essence, and may be made the basis of a definition, of the equiangular spiral."

Thompson conceptualized the evolution of living form. Still talking about the shell he says:

"But God hath bestowed upon this humble architect the practical skill of a learned geometrician, and he makes this provision with admirable precision in that curvature of the logarithmic spiral which he gives to the section of the shell . . . *The same architecture which builds the house constructs the door.* Moreover, not only are house and door governed by the same law of growth, but, growing together, door and doorway adapt themselves to one another."

For me this was more important than any work on architecture that I had read. It had to do with the essence of form. Still talking about the shell:

“It exemplifies very beautifully what Bacon meant in saying that *the forms or differences of things are simple and few, and the degrees and coordinations of these make all their variety*. And after such a fashion as this John Goodsir imagined that the naturalist of the future would determine and classify his shells, so that conchology should presently become, like mineralogy, a mathematical science.”

Thompson also talks of achieving infinite variety within repetitive systems. This touched the core of what for me is a central issue of architecture today – being able to create variation and permutations of dissimilar objects within repetitive systems. He was discussing the *raison d’être* of a single living organism, and I was extending this thought to the organism of environment.

Nature makes form; form is a by-product of evolution. The science of morphology deals with the reasons for the evolution of particular forms. One can study plant and animal life, rock and crystal formations, and discover the reasons for their particular form. That helps us to understand what man’s form-making process could and should be.

The nautilus has evolved so that when its shell grows its head will not get stuck in the opening. This growth pattern in morphology is known as gnomonic growth; it results in the spiral formation. It is, mathematically, the only way it can grow.

The same is true of achieving strength with a particular material. Look at the wings of a vulture, at its bone formation. A most intricate three-dimensional geometric pattern has evolved, a kind of space frame, with very thin bones that get thicker at the ends. The main survival problem for the vulture is to develop strength in the wing (which is under tremendous bending moment when the bird is flying) without building up weight as that would limit its mobility. Through evolution the vulture has the most efficient structure one can imagine, a space frame in bone.

For each aspect of life there are responses of form. Consider the relationship of a maple or an elm to sun. These trees are in a temperate climate and need to absorb a great deal of sun. They have wide leaves arranged in a spiral grouping that exposes the maximum area of leaf. In contrast the olive tree has a thin leaf. One side is light, one dark. The leaf rotates so that the light side always faces the sun, because it is essential to its survival that heat not be absorbed and that moisture be preserved. The same is true of many cacti, which turn themselves perpendicular to light. In the forest we find plants that usually grow in shade under trees develop larger and broader leaf forms and spread themselves. Each plant develops a form that responds directly to its survival needs.

One of the bees’ problems of survival is to store honey and so through evolution they produced a space pattern that stores a maximum of honey using the least possible wax. Their three-dimensional system of space packing is a very efficient way of storing fluid.

Economy and survival are the two key words in nature. Examined out of context, the neck of the giraffe seems uneconomically long but it is economical in view of the fact that most of the giraffe's food is high on the tree. If the absorption of light is essential to survival, then large, seemingly uneconomical leaves are developed to absorb it. Economy and survival are interacting forces. Beauty as we understand it, and as we admire it in nature, is never arbitrary. It is a by-product of this complex interaction: the color and shape of flowers directly relate to their ability to attract insects; the color and formation of insects relate to their ability to camouflage themselves against the background of flowers. Form and pattern are constantly related to the needs of survival.

Thinking of architecture in terms of the morphology of living organisms was an important step. As soon as you compare the design process of an environment to the morphology of an organism you become aware of the crudeness and the arbitrariness of the man-made forms. Because of the limitations of our understanding and primarily because of the limitations of our means of building, our environment is a caricature of the perfection that man might achieve. It is the imperfection, the gap between the complex life-function of environment and the forms and structures we have made, that creates the duality between the urban, and the organic and natural.

We experience this every day. We have two kinds of distinct feelings in the environment, one which we associate with being in the city, the other with being in the open country – the sensations of walking in the forest under branches and leaves swaying in the breeze. The contrast is recognized whenever we feel the need to withdraw from the urban environment and go back to nature, which restores in us a certain peace and stability. This difference between walking in the urban street, in man-made structures and being amongst the trees, rocks, and water has to do with the difference between being in an environment which approaches perfection in its natural response to the demands of function and survival, and the one made by man which is an imperfect solution to equally complex demands. I believe that as the man-made environment approaches the perfection of the form fulfilment of natural organisms, this separation between the man-made and the natural will disappear, that we as men will be equally fulfilled in either man-made or natural environments.

Let me illustrate this in terms of a building problem. The eye is a complex mechanism; it changes with light conditions, the pupil expanding or shrinking, the eye rotating in different directions, or focusing to different distances. Compare this to a window in a structure; a fixed pane of transparent material in a wall. Yet what we ideally require of a window is not unlike what the eye provides. The window should shrink or expand according to the quality of light and the time of the day and the season. It should move in and out of the wall in response to the sun's penetration and the direction in which we are looking through it. Its transparency should vary, sometimes allowing all light through,

sometimes very little. It should have the quality of becoming instantly opaque. It should expand and shrink like the shutter of a camera.

Think for example, of a roof structure with straight beams and columns, and compare it to the intricate three-dimensional fabric of fanning and folded cantilevering in the leaf of the palm tree, a perfection of accommodating stresses with the minimum materials in the most intricate but ordered pattern. Columns and slabs and beams can be geometrically more accurate, but expand this to walls and spaces, and to movement of air and climate, and to the subtle needs of man's psyche, and you have an architecture infinitely more simple yet apparently more complex.

Thus it has become fundamental to my whole attitude to architecture that we must consciously live this kind of process in understanding the nature of our environment and of the materials and processes that produce it. This will progressively result in a better environment. It is complex because the forces that shape human environment are both physical and psychic. The primitive American Indian, who feared nature, expressed this in his spirits, made masks of their images, and hung them in his doorway to protect him. He was satisfying a psychic need; so it was not arbitrary.

Once the environment is thought of in terms of morphology, then it is easy to see and say that the environment is made up of a multitude of *structures* and that the understanding of these structures is essential to the understanding of the design process. This use of the word "structure," to mean the many facets of the morphology of environment, challenges the conventional architectural use, i.e. that which holds the building up. By challenging this limited meaning of the word we expose a serious shortcoming in our attitude towards design.

When I was a student at McGill, the work of Mies van der Rohe was admired because it was said to express structure. If a building had a frame of steel beams and columns then, instead of hiding it, Mies came right out and put it on the surface. Peter Collins, who taught us history of architecture, used to say, "This is rational design because it expresses structure." He would talk of "rational architecture." "The work of Le Corbusier is totally irrational," he would say. "It does not express structure." As a student I suspected this view because intuitively I felt I would rather be in an environment made by Le Corbusier than one by Mies van der Rohe. Where had the argument gone wrong? It gradually became clear to me that we were misusing the word "structure." We were using it merely to describe the skeleton that holds a building up.

Now as the word "structure" is used in morphology its synonyms are: *organization*, *complex*, and *arrangement*. Each aspect of form is an aspect of structure. The structure of a building is not just what holds it up; it is also the structure of light, the structure of air, the structure of the distribution of services through it, the structure of movement, the psychic structure of human

response to location, identity, and privacy. All these are *structure*. While Le Corbusier did not exaggerate the expression of what held his building up, he did respond in a more organic way to light, say, or to movement, whereas Mies, while expressing the fact that his building was made of columns and beams, denied most of the other aspects of structure. The sun moves in the sky. It is weak and low in winter, strong and high in summer. Our relationship with the sun varies with the time of day and the time of year. A tower with identical glass walls facing in four directions is ignoring the structure of light.

Even the argument that Mies' buildings express what holds them up is misleading. If you consider the fact that a tall structure is not only affected by the force of gravity but by horizontal forces of wind and earthquake which are almost equal in magnitude, then the arrangement of vertical and horizontal columns and beams is the most inefficient structure you could have. Like a house of cards it tends to want to collapse. The entire strength is dependent on the stiffness of the joints, because it lacks any form of triangulation to make it rigid. In contrast, Buckminster Fuller's geodesic dome is an organic structural response to these forces, a geometric arrangement which is self-stiffening.

Environment is made up of a multitude of structures. Some of these structures or functions are physical and some are psychological. It's important to put this in historical perspective. It was Louis Sullivan who said: "Form follows function." It was the CIAM architects, who, in the twenties and thirties, responded to it. The whole problem of arbitrariness in design was being questioned. This was a fresh open-ended development, yet it was over-simplified. For example, CIAM's charts would show that the height of a building should be related to its distance from the next one in such a way that the sun would hit each building. From this chart they would generate a scheme of ten rows of town houses equally spaced and this, they said, was a response to function.

By the fifties, many architects were saying, "Functionalism is dead. It's monotonous, it's boring, we have to have 'a rich environment,' we have to have 'delight'." So, they started playing stylistic games with grilles, ornaments, and decoration. But the ten rows of town houses, equally spaced, are a gross over-simplification of function. The sun doesn't stand still, it goes round in an arc, and the angle of the arc changes every moment of the day and from one day to the next. If one were to make an arrangement of houses that took this fact into account then, through the same response to function, one would arrive at the most complex and visually rich arrangement in space.

This reaction of the fifties occurred not because the basis of functionalism was wrong but because it didn't go far enough. Rather than reacting in such a retrograde way and going to a world that is arbitrary and stylistic, the dominating approach in the architect-designed environment in North America - what little of it that is left - we must explore the fundamental nature of living form. When we talk about structures, the infinity of structures, it's important to avoid

the danger of isolating and exaggerating any particular aspects of them. I am making a movie with the National Film Board of Canada. In it, a man designs a tree. He's never seen a tree before. He writes down all that is important: fluid must flow upwards; sun has to come downwards; cells reproduce in a particular way, and so on. But, alas, he forgets about wind. He makes a beautiful efficient tree, except that it has no trunk. It's a dome of leaves with a network of branches. As he finishes, a storm comes and blows the whole thing away. Now he designs another tree. He takes all the leaves, puts them in a little box and hangs them on the trunk, thus eliminating all the branches. It is a much more economical tree, but it won't survive because it needs a certain area of exposure to the sun to produce its food. Moral: economy is directly related to survival.

I've been in dozens of meetings with housing officials who would sit back and say: "That's uneconomical, we don't want a garden, we don't want open space, we don't want this, we don't want that, we are perfectly happy with the standards we have." Architects have said, "Habitat is uneconomical because it is an open structure. If you had put the houses in a closed pattern and reduced the area of outdoor spaces, roofs, and exterior walls, it would have cost much less." That is absolutely true. But it is my belief that having an outdoor space by your house, and daylight, and the ability to identify your dwelling, are essential to survival. I conclude that it is a moral obligation to make, with the least possible material and labor, an environment that satisfies the requirements of survival; that is, among other things, an environment that expands man's life and aids his spiritual growth.

It is much easier to comprehend the physical aspects of structure than the psychological ones; we have enough common precedence in natural organisms. Psychic structures are particular to the environment of man. Their fulfilment is equally as important as any of the physical; they are the pivots of man's well being.

I became aware of the depth of this concept when working on a joint paper for an Aspen Design Conference with Christopher Alexander. Irritated by the conference's theme, "Order and Disorder," which was inspired by Ben Shahn's call for the value of disorder, we decided to analyze some basic psychic structures, those usually associated with disorder – identity, the need for variety, and how an individual can affect his own dwelling, the need for change. Essentially, this is what we said:

"People want to feel that they can shape their own personal environment, they can change it, they can modify it, they can choose it, that it's not imposed on them, and they like to feel that it's not the same as everybody else's, because they are not the same as other people. In fact, the ideal would be dwellings that are as different from each other as human faces and personalities are different from each other. This seems to be true of most societies. There are very few where conformity of the individual to the overall group is so strong that he does

not have that need for identification. But there are certain societies where the identification isn't to the individual but more to the immediate group, such as the Indian pueblo. The individual felt so much part of his tribe that he was satisfied with that kind of identity, and so the physical environment expressed it. The pueblo was the identity of a tribe."

The need for identity in the dwelling appears to be a basic human need that goes back to even simpler forms of animal life, as Desmond Morris in his book *The Naked Ape* suggests:

"One of the important features of the family territory is that it must be easily distinguished in some way from all the others. Its separate location gives it a uniqueness, of course, but this is not enough. Its shape and general appearance must make it stand out as an easily identifiable entity, so that it can become the 'personalized' property of the family that lives there . . . Endless rows of uniformly repeated, identical houses have been erected in cities and towns all over the world. In the case of blocks of flats the situation is even more acute. The psychological damage done to the territorialism of the families forced by architects, planners and builders to live under these conditions is incalculable."

The degree of individual and community identity varies from culture to culture. You could draw a graph showing the shift from more community and less individual identity to the opposite, and you could place cultures at various points along it.

At the conference both Alexander and I proceeded to demonstrate the possibility of physical systems that could respond to this one aspect of psychic structure. Each of us independently suggested ways in which an individual could differentiate, change, and identify his own environment, thereby producing certain qualities which Ben Shahn may have associated with the term *disorder*. Just as this psychic structure of the environment generates the need for formal response, so each other aspect of the psychic structure – whether it has to do with our perception of space, the qualities of environment conducive to learning or working, or the relationship between individuals living together – must be part of the total design fabric.

Morphology is the key to understanding the physical organism of environment and this understanding is a key to better design. But understanding is not methodology and it is this methodology of design which still remains a deep mystery.

