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Analogies between nature and architecture

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ANALOGIES BETWEEN NATURE AND ARCHITECTURE

by

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ABSTRACT

ANALOGIES BETWEEN NATURE AND ARCHITECTURE

by

Joaquin Diz

Nature is a wealthy source for referral during the creative process of architecture. It has thus been employed throughout history in different ways by different architects, each time providing new foundations for further interpretations.

In this project, both, the site (Big Bend National Park, Texas) and the program (World Center for Birds of Prey), inform the architecture. The first through its geology, topography, history, and spirit, the second through the historical relationship between humans and falcons as well as the difference in their inherent freedom of spatial displacement. This information is abstracted into architectural forms based on essences and not on literal interpretations.
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INTRODUCTION

Without experiencing the fragrance of flowers, without witnessing the soaring of great birds, without the expansive sky and sea, without breathing the freshness of morning air, without sunlight, without the soft crimson of the dawn - without all this, our minds and emotions and sensitivities are empty. We become autistic.¹

The reference to nature in architectural production can be traced back to immemorial times. Egyptian Architecture was articulated by means of plant motifs. The most outstanding were the rich variety of columns, where one can find closed and open versions of papyrus and lotus columns as well as palm columns. Baroque Architecture developed complex plans formed by interpenetrating cells which produced energetic forms or spaces that resembled pulsating organisms. In the recent so called Modern Movement, reference to nature evolved into both a more, abstract and energetic form, especially with the "organic movement."

Frank Lloyd Wright, the person who coined the word "organic" in architecture, insisted that there was a wealth of information in nature if architects would observe carefully.² One can find forms which have evolved through millenia; articulations between the same and different materials, textures and light; and different ways in which spaces are defined and given character. The sharp edged boulders on a mountain site give a far more aggressive perception than that of one which has been smoothed out by glacial or water erosion. The space under a willow is defined by its hanging branches and given a certain quality by the light yellow leaves and the sun's rays spotting the ground and moving with the wind which at the same time provides music as it flows through the elongated leaves. The information that this space can provide varies greatly with that given by the space under a cactus in a dry desert, where the shade only moves as the sun

crosses the sky. But in any case, the contact with nature stimulates all the senses by means of which our mind receives data to form mental structures.

I have selected only a few of the many architects that refer to nature throughout their design process, and whose ideas have a continuum in today's architectural production. By no means do I intend to present the totality of their work or concepts, I have just abstracted their basic ideas with reference to nature and architecture and how they have evolved through time.

Antonio Gaudi:

"And then we came at last to the "Sagrada Familia"; lifting his head and looking up at its spires, Gaudi asked me: "Don't they somehow remind you of Mont. Salvatge's rocky peaks?"" 3

Gaudi rejected formal abstraction, saying that ornament should be figurative. He believed that the closer his sculpture came to conform to God's creation, the better it would be. His work was deeply rooted in his Roman Catholic beliefs and in his cultural background as a Catalan. Photography, the discovery of the century, was employed in his creation process, letting his sculptures be like three-dimensional photographs.

He studied nature to the core. The skeleton was for him the very principle of its spiritual expression. As he said, "The expression and appearance of an individual derive from his skeleton." 4 Natural and organic forms were not only limited to ornament superimposed on the building but go on to constitute essential structural elements, as in the case of bone-shaped columns or even his studies on the catenaries.

It was not enough, in his opinion, to represent nature skillfully, there had to be an order and context. For example, the middle doorway of the Sagrada

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Familia’s facade represents the "grotto of Bethlehem, full of flowers and birds in flight. Nebulous and imprecise forms emerge from the archivolt. His use of intense azure evokes the color of a clear winter night with constellations of white almond flowers and twinkling stars. The constellations of the zodiac are shown in their exact position: Taurus and Gemini where they happened to be on the day of Christ's birth, with the great Star of the East above the Pessebre." 5

Gaudi's architecture has been inspired by various natural sources. It is well known that the Catalan geology has a great influence on his design, it can be easily read in his Casa Mila. He frequently went to Montserrat, where he was struck by the outcrops of sandstone with its strange polished reliefs from which he adopted forms and the dynamism for some of his constructions (Fig. 1 & 2). Another example could be the helical development of sea shells in an upright position which might have inspired him for the towers in La Sagrada Familia (Fig. 3 & 4).

A conversation between the architect and the painter Carles on the roof terrace of the Casa Mila, may help show, in part, how he observed nature:

"How," Carles asked, "do you justify the curvilinear forms and volumes of this facade?"

"They justify themselves, for they are united to those of the mountains of Collcerola and Tibidabo, which you can see from here."

"But from here, from the top of the Casa Mila, one also has a view of the sea, and the horizon line is straight!"

"The straight line does not exist in nature!"

"Nature isn't mathematical, but, a regular form, a style, is pleasing to the mind. Anything that isn't chaotic satisfies man."

"But the idea is that one must not try to satisfy him!" 6

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6 Ibid. p. 165.
Fig. 1 The rocks of San Miguel del Fay by Juan Matamala.

Fig. 2 The outcrops near Montserrat in the middle of Catalonia.

Fig. 3 Sea shells in upright position.

Fig. 4 Gaudi, Barcelona, La Sagrada Familia.
The horizon line which can be seen from the roof terrace of the Casa Mila makes the mountains of Collcerola and Tibidabo stand out, enhancing both the horizontal and the vertical, giving each other meaning. It is necessary for there to be a horizon or base for an outcrop to exist; the reciprocal is not true. The creative process works in a similar way. Gaudi's work, as creative and original as it was, by being created enters the realm of human knowledge to then form a horizon for future creations. Within this horizon Santiago Calatrava finds part of his inspiration to create new "topography", new concepts. "Our clear concepts are like islands which arise above the ocean." 7

Santiago Calatrava

Beyond sharing Gaudi's nationality, Calatrava continues his structure- and nature-oriented inspiration. His interest in foldability and mobility and especially in the idea of a kinematic system applied to construction, has taken him to study this aspect of nature. Like Gaudi, he has looked at the structural system of vertebrates and how they provide movement as well as stability. Without a doubt the bone structures have inspired his production, particularly his objects or sculptures.

At an interview, he once said:

At a point in time I devoted myself to the study of organic forms, with which my work has some similarities. This is the result of an option. And which has not so much to do with the fact of how to solve a given structural problem... My work is figurative rather than organizer, in the sense that I am interested in certain sculptural-anatomical relationships... Working with isostatic structures almost inevitably leads one to nature sketches. When a dog stands on his four legs, it constitutes an isostatic body. The load is divided by the number of legs, there are no embeddings other than those supplied by the muscles... 8

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8 El Croquis De Arquitectura y De Diseno, #38 Monografia Santiago Calatrava, February-March 1989, p. 10. Interview by R. Levene and F. Marquez.
Like Gaudi, he wants to provide his building with a spirit of its own. Nature is not only a conceptual analogy, but also a symbolic image that tries to express the existence of life in his structures. In many cases his conceptions start from a sketch of nature (Fig. 5, 6, & 7) which later unfolds into architecture. He also refers to his work in natural terms. For example, the Galleria at BCE Place in Toronto, Canada was shaped to suggest trees and bowers of the Ontario landscape. Others do not need sketches or words to recognize their origin, like the annual Cement Pavilion in Basil (Fig. 8) or the moving ribs in Expo Sevilla.

Nature has served as a model and inspiration for many other architects and engineers in the field of structures, particularly in wide-span constructions. In the 1920s Franz Dischinger and Walter Baversfeld evoked a comparison between their reinforced-concrete shell structures and an egg shell. Many others like German Frei Otto brought up other comparisons.

The evolution of ideas is analogous to the biological evolution, where an idea evolves from a horizon of knowledge, but that horizon had previously evolved from another. We could keep going back to what Husserl, Merleau-Ponty, and Heidegger refer to as the "primal" horizon. In biology this would be the first living cell from which the race of evolution started.

Fig. 5 Sketch for annual cement pavilion in Basil.
Fig. 6 Sketch for bridge over the River Guadalquivir.

Fig. 7 Sketch for bridge over the River Guadiana.

Fig. 8 Annual cement pavilion in Basil.
Louis Sullivan

He stressed that "during childhood his lyrical instincts were allowed to develop properly by uninhabited contact with the land on his grandparents' farm. . . . he claimed, he saw in nature analogies of his own physical sensations."9 From an early stage in life, Sullivan indulged his mind in the perception of nature, stimulating all his senses. This personal perception was essential to his creative mind. Maurice Merleau-Ponty insisted on the primacy of perception over strict or objective reality. The way in which each person perceived the world could inform different realities.10 "The first truth of the world is not the truth of mathematical physics but the truth of perception; or rather the truth of science is erected as a superstructure upon a first foundation of presence and existence, that of the world lived through perceptually."11

In his book Kindergarten Chats, he makes clear the need for an intuitive understanding of nature's process of creation and the ability to express this knowledge through art and life. This "drawing in" and "putting out", as he expresses it, establish the fundamental rhythm of the relationship between man and nature. He believed that "a balance of reason and emotion sustains the cosmos that emotion (expression) is intuitive and reason (structure) intellectual, and that only those who understand this balance are able to create art that reflects nature."12 This concept led his architecture to be based on an "intellectual" structural grid which expressed its function, to support, while ornamentation was left to the "emotional" expression, which was based on organic derivations. These two simultaneously represented masculine and feminine qualities. He favored an anthropomorphic image, contradicting his phytomorphic expression.

"Ornament should come forth from the very substance of the material as a flower appears

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amid the leaves of a plant."13 In his Wainwright Building, St. Louis(Fig. 9), clearly shows this concept where the vertical structure (masculine) is free from ornament, while the horizontal structure (feminine), the expressive part of the building, is highly decorated with plant motifs. The same could be said of his Bayard Building, New York (Fig. 10), onto which he also incorporated female figures (Fig. 11).

He believed that, as in nature, the outward appearance had to be the image of its essence. "A building, to be good architecture, must, first of all, clearly correspond with its function, must be its image."14

In an article written in 1896, by observing the behavior of nature, he stated "that life is recognized in its expression, that form follows function."15 From this observation, he derived the principal: ". . . that it is really the essence of every problem that it contains and suggests the solution."16

The analogy of architecture with nature led to an ontologically and not mechanistically founded version of Functionalism.

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Fig. 9 Wainwright Building, St. Louis.

13 Ibid. p. 65.
14 Ibid. p. 65
16 Ibid. p. 208.
Fig. 10 Bayard Building, New York.

Fig. 11 Bayard Building, New York. Female figure.
Frank Lloyd Wright

He took the ideas of Sullivan, his "Lieber Meister," further by unifying form and function under "organic architecture." Again a previous architect formed a horizon for a future architect to "plunge off". For him the relation between parts to the whole was an essential feature. Like in nature each part should have its own identity but at the same time be inseparable from the whole. In the same way that nature was functional and carried its own decoration, architectural decor should grow organically out of the structure into doors, windows and other functions. "A building can only be functional, when integral with environment and so formed in the nature of materials according to purpose and method as to be a living entity. . ."\textsuperscript{17}

He believed that nature was capable of informing the architect through its principles, and from these, form and method should emerge, not as a literal reproduction. Nature was a source of design inspiration, a model for architectural forms and construction principles.

Trees, he said suggested the "tap-root" foundation of the Johnson Research Tower in Racine, Wisconsin (Fig. 12), wherein the floors were cantilevered like branches from the central "trunk" (of elevators, utilities, and stairs) sunk deep in the ground to stabilize the structure (like a tree above ground and a dandelion below). Wright liked to say that the spiraled, chambered nautilus inspired the Guggenheim Museum in New York City and that folded hands ("here is the church and here is the steeple . . .") informed the prow like glass facade of the apse (Fig. 13) in the Unitarian Meeting House, at Madison, Wisconsin. The walls of his midwestern fieldstone houses (Fig. 14) resembled rock strata in the vicinity of his Spring Green estate, and the way some flowers opened informed the plan of certain prairie homes.\textsuperscript{18}

Wright had a platonic attitude, believing that essence existed before perception and it was this essence that he insisted should be discovered in nature. But this

discovery could only come from diligent contemplation. Reality and truth are not to be found on the surface of things; they are hidden and recoverable only after extensive probing. In the same way that essence existed in nature, he believed architecture should have an essence, an "idea". What it was, was more important then its looks. The house was the embodiment of the nature of the family, the physical environment, the culture, the architecture, and the construction processes.\textsuperscript{19}

His Guggenheim Museum in New York (Fig. 15) is the public building which comes closest to the ends of organic architecture, its form coming from its function and it expressing it to the exterior. There are no superficialities, only that which is needed to comply with its functions.

Other architects took Sullivan's and Wright's "organic" ideas further. Bruce Goff, who admired Wright, started teaching at the University of Oklahoma in 1946 where he was committed to the organic philosophy. He explored the three-dimensional geometry further than Wright, ordering his projects by the use of circles, triangles, stars and logarithmic spirals. Some followers of this "organic architecture" today are Bart Prince, Ralph Rapson, Joseph Esherick, Gunnar Birkerts, Fay Jones, and many more.\textsuperscript{20}

\textsuperscript{19}Ibid. p. 312.
Fig. 13 Unitarian Meeting House, Madison, Wisconsin.

Fig. 14 Stone work in the Howard Anthony House, St. Joseph, Michigan.

Fig. 15 The Guggenheim Museum, New York.
PROGRAM

"World Center for Birds of Prey".

It is principally a research and conservation center for endangered birds of prey, especially the Peregrine Falcon. This program allows me to introduce an interesting dimension to the previously stated relation between architecture and nature, by incorporating the human - bird relationship.

The program is similar to an existing center in Boise, Idaho (Fig. 16 & 17), from which I have obtained most of the information and programmatic requirements which can be divided into three basic functional areas:

a) Scientific: Consists of spaces created for scientists and birds. These areas are restricted to the general public. The birds are housed in nesting rooms free of human sight and disturbance. In plan, a rectangular shape of 6 x 3 meters is sufficient for each couple. They must receive morning or afternoon direct sunlight as well as good ventilation. Scientists approach these rooms only once a day to provide food and water. The number of visits increases in spring when more activity takes place due to the manipulation of the eggs and newly hatched. Only a few other occasional visits will interrupt their tranquillity. Most of the observations are done through video cameras located in each room. Other facilities must be placed, like branch and stone perches, shelves, and a bath, for their normal activities to take place.

Holding rooms must be provided for placing the birds when nesting room needs to be temporarily vacant, for example when it has to be cleaned.

The laid eggs are sometimes left in the nest to be hatched by their parents, but in most cases they are extracted and placed in incubators until they hatch. The space for this function must be climatized and free of disturbance. No direct sunlight must be allowed on the incubators, and it should be able to darken. Proximity to nesting area should be taken into account.
The newly hatched birds are then taken to another room, the brooding room. Here they are handfed and examined for a short period of time. This room's requirements are the same as the previous one's. From this point some are taken back to their parents or foster parents, but the majority are placed in a third room, the post-brooding room, where they are looked after for up to 14 days. Its requirements are the same as the two others'. All three must have an additional room each where records are kept and medical interventions may occur. From here the young birds are taken back to their nests or imprinted by humans and trained into falconry.

Imprints are birds that due to their constant contact with humans are brought up to believe they are humans or vice-versa. Their behavior makes them adequate for artificial insemination, and if flown daily, by means of falconry techniques, they acquire a better attitude obtaining better results. Simultaneously, the flights providing an attractive educational entertainment for the viewer. These birds are kept in spaces similar to the nesting rooms but smaller, and only one bird per room. They must be exposed to the public's view and in direct contact with the scientists.

Scientists must have offices where they conduct their research. Here is where the monitors for the nesting room video cameras are located, through which constant observations are made.

The birds' food must be healthy, free of disease and chemicals, so for a better control it is produced in this center. Chicken and quail form their basic diet into which some vitamins and minerals may be added if required. Space for its production, preparation, and refrigeration must then be provided.

b) Educational: This area is accessible to the general public. A permanent exhibit should be incorporated, dealing with the evolution of the flying animal throughout time and the origin of birds of prey, the different species and their characteristics, the history and practice of the art and sport of falconry, and the need for
their preservation. This space must be in visual contact with the imprints which form part of the exhibit, and from it one must have access to the flight exhibit grounds.

There should be a shop that provides relevant material and souvenirs, as well as a library for the use of scientists and the general public. Since lectures and courses will be given, space for these activities must also be provided.

c) Administrative: Semi-restricted to the public. This area consists basically of office space and a meeting room, as well as space for supporting functions like computer, photocopy and coffee rooms. Besides directing the scientific and educational departments, it covers several other activities like fund raising and national and international service offerings, since this center is concerned with any bird of prey in danger of extinction.

All three areas are backed up by services for which room must be provided. Although the program can be divided into three distinctive areas, there are many functions which are interconnected giving unity to the whole.
SITE

Casa Grande, Big Bend National Park, Texas.

Past volcanic activity has given form to the Chisos Mountains, wherein Casa Grande is located, making them stand out from the arid horizontal desert (Fig. 18 & 19). The earth's internal activities have created interesting tilts and forms on the desert surface, where one can constantly read a dialogue between the horizontal and the vertical (Fig. 20 & 21). Upon these vertical outcrops new life grows, animals and vegetation alike. They grow out of the "new" mountains in the same way new ideas and creations grow out of the old.

One of the species which is inhabiting the heights is the endangered Peregrine Falcon. They have selected this land which has dynamics similar to their own. In the same way that the molten magma pushes through the horizontal crust forming these vertical outcrops, the falcon breaks its horizontal flight to drop in a vertical stoop to catch its prey. The local Comanche would say that the mountain and bird have the same spirit. The ancient Greeks would select the site for their temples in the land where the god's spirit dwelt. For the ancient Egyptians the falcon was a god, Horus. Casa Grande in Spanish means "big house". This is the site for the big house of the birds.

My site is on the southeastern side of Casa Grande (Fig. 22). This side is hardly ever seen since there are no trails or roads leading to it. The cliffs offer a dramatic sight, and it is at the base of these, where the slowly lifting horizon meets the vertical, that I have located my site. It is also here, on the southeastern side, that a couple of Peregrine Falcons have naturally located their nest (Fig. 23). A paved road approaches the mountain from the north. It then surrounds its base to the west where it ends in the Basin, a small town where one can find the ranger station, tourist lodging, and a few commercial buildings and residences (Fig. 24). The Lost Mine Trail leads off the paved road to the east going up a gentle slope to a ridge that overlooks the Juniper Canyon. The proximity of the site to the paved road allows for a minimum road construction for access.
and other infrastructure, and the proximity to the Basin backs up the center with services that it might require.

In 1935 this area was set aside as a National Park for the preservation of the area. This program would contribute to that end.

Some facts and legends: Big Bend has a long tradition with flight, it is here that remains of the largest flying animal have been found, a pterodactyl. It is here that the air force would test its airplanes during and between the world wars, and it is here that today the Peregrine Falcon dominates the three dimensional freedom flight.

After the summer rains had filled up the water holes, and during the September full moon, the Comanches would cross this area through what is known as the Comanche Trail, on their annual southern migration. Along the way to Mexico they would raid and slaughter any settlement. This became known as the "Comanche Moon". At about this same time of the year the Peregrine Falcon starts its southern migration, and the action of these birds on their prey is similar to that of the Comanches. Humans and birds are then linked together, one on the ground, the other in the air.

There is a legend held by the natives that says that "Sanuwa", the Peregrine Falcon, is a mortal enemy of "Uktena", the snake, and that one day 'several young "Sanuwa" fledglings were consumed by an "Uktena", and their parents, upon returning to the nest, tore the serpent into pieces." This legend was used to show the conflict between the upper (falcon) and under (snake) worlds, between order and chaos. "The Under World was one of chaos and disorder . . . The Upper World, on the other hand, epitomized perfection and purity." The reason why the Peregrine Falcon has entered the list of endangered species is due to the extensive use of DDT as a pest control. The poison builds up on the

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23 Ibid., p. 290
last link of the food chain, the predator, and its effect on the falcon is that the shells of the laid eggs are too thin so they break under its parent's weight. So it can be said that humans represent "Uktena" in the legend, for being the cause of the fledgling's deaths.

Another interesting legend from this area is that of the Lost Mine. The Conquistadores held Indians in prison at the Presidio de San Vicente and used them for working a mine. It is said that the Indians were blindfolded and made to march all the way to the mine in the Chisos Mountains. Legend has it that the hidden doorway to the mine is located where the sun's rays first light the peaks of the Chisos Mountains on Easter morning if looking from the doorway of the old Presidio.\textsuperscript{24}

\textbf{Fig. 18} Volcanic activity forming outcrops.

\textbf{Fig. 19} The Chisos Mountains in contrast with the horizontal desert.

\textsuperscript{24}Ross A. Maxwell, \textit{The Big Bend of the Rio Grande} (Austin: The University of Texas at Austin, 1979), p. 51.
Fig. 20 Earth's crust broken and tilted.

Fig. 21 Development of some of the topography.

Fig. 22 Map of Casa Grande.
Fig. 23 Casa Grande, selected by the falcons.

Fig. 24 The Basin and Casa Grande.
PROJECT

The building can be divided into two horizontal layers, the human world, and the bird world. This division comes from the abstraction of their inherent displacement freedom. Humans, by nature, have been created to roam on the surface of the earth; we have a two-dimensional freedom. The birds on the other hand dominate the sky with their three-dimensional freedom. This abstraction has been represented functionally by placing the predominantly human activities in or on the ground and the birds' in the air.

As I have mentioned before, the humans extensive use of D.D.T. has been the main cause in the Peregrine Falcon population decline. For this reason the humans could be interpreted as the "Uktena" in the Indian legend, thus representing the Under World of chaos. The human part of the building, that which is "grounded", seems to lack any order, while the bird part, the legendary "Sanuwa's" part, representing the Upper World of order and purity, has a clear structure, a structure with certain similitude to a skeleton which both, Gaudi and Calatrava, were and are, respectively, very fond of.

The forms of the apparently chaotic "Under World" derive from those that form this land, by the tilting and turning produced by the earth's internal forces. The angles of the building in plan come from certain geological angles found in Casa Grande (Fig. 25). This analogy between the architecture and the land can be traced back to Gaudi's work, when he referred to the topography of Catalunia. The same could be said of Wright when he referred to the rock strata in the vicinity of Spring Green estate. This part of the center is constructed with local stone, and by means of different techniques, a variety of surface textures is given. This system does not require the finishing perfection others might, and in so doing, contributes to that "lack" of order.

The systematic structure of the "Upper World" provides a horizontal reference for the chaotic "Under World". It is built out of prefabricated parts of aluminum providing minimum weight and good resistance. Structurally it is composed of two
parallel trusses which are joined from above and below by ribs that bridge between them. The roof is made of stretched canvas and reinforced with wire within its fabric, which provides an order on its own.

A tower extends out of the "chaos" to intersect the horizontal of the "order". Here is where humans meet birds, where chaos meets order, where the Under World meets the Upper World. The verticality of the tower and the horizontality of the "wing" recall the spirit of the site, incorporating it into the building. This spirit has been represented in the site model which is based on vertical and horizontal components, the verticals by a more massive element, wood, and the horizontals by a lighter one, wire (Fig. 26 & 27).

Description: An access road takes us from the paved road to the ridge, following what used to be the Lost Mine Trail. From the ridge, the general public approaches the center by foot. Scientist and other employees that live in the Basin, have access to electrical carts (Fig. 28, 29 & 30). The trail nears the building from the east, offering views at different angles, in a similar way to a Greek temple approach. As we come closer to it, the "Under World" construction takes more importance than the horizontal form above, which, seen against the background cliffs, seems to hover between them. The massive stone walls of the center dialogue with the back cliffs (Fig. 35). After walking alongside the stone wall to the far south, one passes underneath the overhanging roof, marking the entrance to the site (Fig. 36). The final approach to the building is from the west. From here, the outstanding feature is the horizontal "Upper World" which now is seen against the sky and the horizon (Fig. 37).

The whole experience of approaching the building presents a dialogue between it and its surroundings and therefore with the vertical and the horizontal.

One then goes under the roof to the entrance which is a "big hole" in the tower (Fig. 38). It recalls the entrance to a mine, the Lost Mine. Since it is in the
tower, and the tower is the highest part of the building it will be the first to receive the sun's morning rays, so, according to the legend, the doorway to the mine should be there.

As I mentioned before, the tower is the link between the two worlds, so in the upper half of it are the incubator, brooding and post-brooding rooms, where the humans assist the birds, as well as the entrance to the "Upper World" of order. All these areas are restricted to the general public, accessible to scientists by stairs or elevator (Fig. 39).

Within the tower, as one descends the central stone stairs, one can read the evolution of the flying animal which is exhibited against the stone walls, petrifying history like fossils. From above hangs a replica of the largest pterodactyl ever found. Light enters this interesting space through slots made on the southern wall, from above, and from the entrance (Fig 31).

The tower works as a distributor as well (Fig 32). If we turn left at the bottom of those central stairs, there is a ramp that leads to the scientists' offices. This is a large space divided by stairs that go up to the imprints' rooms which hang over the scientists. Since the imprints are birds that believe to be humans, they are kept within the space of "chaos" but housed in an "ordered" room which hangs within this space and made of the appropriate material (Fig.34). At the far northern end of this sector and connected by means of a long corridor, is the birds' food production and preparation.

A visitor turns right at the bottom of the stairs and goes out under the overhanging roof to see the rest of the exhibit which includes the imprints that can be seen through a glass. The floor of this space is made out of wood lifting the viewer of the ground and allowing the rain water to drain freely underneath and form pools in certain places, like, for example, around the edges. These pools reflect the moon recalling the September "Comanche Moon" and the time for the young birds to start their migration south. At the northern end of the exhibit space, one goes out onto this tilted plane where flying exhibits are performed using the traditional falconry techniques. This surface served
as a staging site for the construction of the building. From here a trail continues up Casa Grande, passing by natural nesting grounds of previous Peregrine Falcons.

The visitor could have also gone into the southern "Under World" where the shop is. It also looks out into the exhibit space from the south. From here we have access to the lecture hall and classroom. The library is out on the left, which can be easily read in plan due to its slight shift. This space is lit by natural light through the glazing placed around the penetration of the tower through the roof of the library, bathing the stone textured wall with light. Going down some more stairs or ramps, one comes to the more private administration area. The stairs and ramps are employed here as an architectural device to provide privateness; the further down we go, the more private it gets.

The "Upper World", "the order and perfection", is accessed through the tower and only by scientists (Fig. 33). The nesting rooms are placed on the eastern side of the structure so that they may receive direct morning sun light, simultaneously they would receive minimum disturbance from people. These rooms are independent from the structure, therefore allowing their size to vary like the ones on the southern side which are smaller, for smaller birds and at the same time make the structure lighter. On the western side the roof overhangs, providing shelter for the exhibit as well as a very interesting dynamic space. On this same side, eight holding rooms are placed for keeping the birds temporarily if needed. Where the roof grows widest (at the entrance) additional structure has been placed and a cable from the tower to the roof that not only holds up the roof but is also a marker for the entrance.

In the same way that the tower interrupts the continuity of one of the parallel trusses, the humans have crippled the falcons by the use of D.D.T., but this same tower is now providing support in the same way this center does now.
Fig. 25 Site plan. Geological lines in Casa Grande.

Fig. 26 Site model. Horizontals and verticals.
Fig. 27 Site model. Horizontals and verticals.

Fig. 28 Site model.
Fig. 29 Site model.

Fig. 30 Site model.
Fig. 31 Plan of entrance level, 2nd floor.
Fig. 32 Plan of 1st floor and east elevation.
Fig. 33 Plan of "Upper World" and west elevation.
Fig. 34 Transversal section through exhibit and section through tower.
Fig. 35 Model from the east.

Fig. 36 Model from the south, entrance to site.
Fig. 37 Model from the west.

Fig. 38 Model. Entrance to the tower.
Fig. 39 Model. Interior of tower.
CONCLUSION

The major sources of reference for this project definitely derive from nature; either directly from it, like in the case of the geological movements, or from legends which have incorporated nature into its discourse, like the falcon and snake legend. The spirit of the site is transmitted to the building not only through the incorporation of sites' historical anecdotes, but also through the dynamic use of the horizontal and vertical. The building could be discussed in terms of nature, therefore establishing constant analogies between them.

I think it is important for the architect to abstract the essence of nature, like in the case of the bird I have abstracted the essence of flight, its three-dimensional freedom in contrast to the land bonded animals' two-dimensional freedom. The architect who observes nature receives a stimulus to which he responds by creating architecture. The two activities, the stimulus and the response, take place on two different plan. The first comes from one environment, nature. The second acts on a different environment, building material on a site. The two environments obey two different sets of laws. The details in the construction do not represent isolated details in the landscape. There should not be any point to point correspondences between the two planes; each obeys a different rule of the game. The architect's vision is bifocal, associating image with meaning. The architect should see nature in terms of his medium and his preferential emphasis.

The functional, structural, and formal aspects of the building are driven by the same concept, providing an integral building, within its self and its surroundings.
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