Alphonse Mucha, Zodiac, 1896.

Introduction

Floral Obsession is a study based on the exploration in floral conditions and their use in architecture. The study of floral conditions consists of topological figures, of surface articulation, which is veining, rippling, frazzling, and the various chromatic effects. The issue is not just about observing and mimicking the aesthetics conditions that can be abstracted by the use of floral forms. It has a more profound goal, which is the parallel comprehension of contemporary scientific insights.

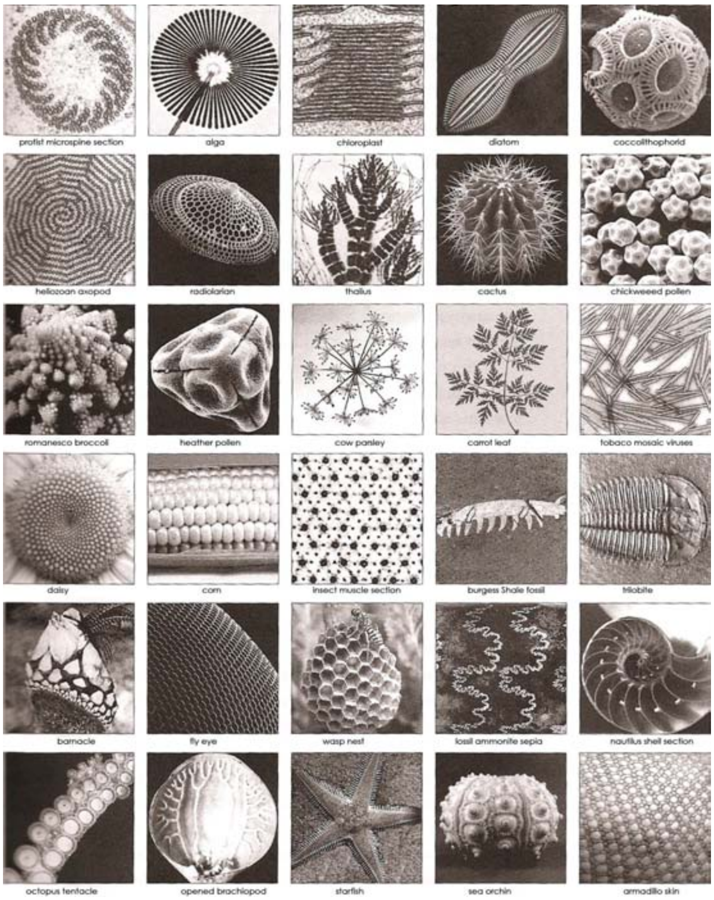
The research is mostly concentrated on what the architectonic implications botany has to add through floral forms. The botany is connected to the intricate of Specimens and Cladistics of species[1]. Specimen represents the study of the properties of the whole population of that species; if that is an animal, plant a microorganism. Cladists coming from the Greek, κλάδος, which means branch, is a branch in biology that determines the evolutionary relationship between organisms based on derived similarities. The cladistic analysis forms the basis for most modern systems of biological classification and groups' organisms by evolutionary relationships.

The use of Floral forms had different interpretation in the art deco of the early 20th Century, as it was vastly used on ormentation. The contemporary use of botany consists of more complex properties, such as growth, reproduction, metabolism, development, diseases, ecology and evolution. Therefore contemporary architecture uses computational power to develop architectonic entities.

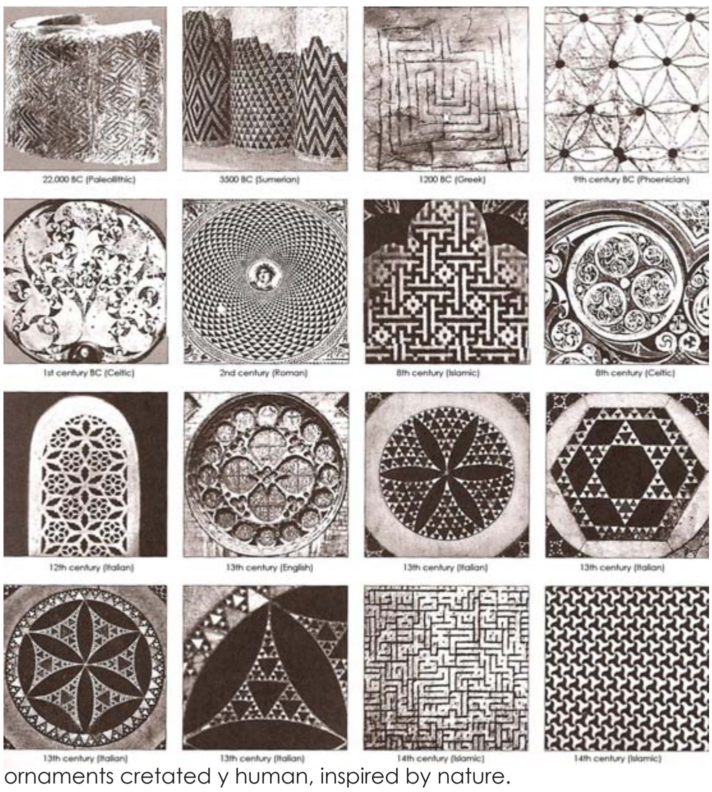
Architecture evolving botany

While studying the structure of the flower many architects reached some dymanic results to interprete them into architecture. Either in a very literal wayor by 'borrowing' elements and basic principles. There are many such deigmata in the ancient history, where the decoration of classical columns were based on floral geometries. There have been many attempts to transfer all this research information onto a buiding, mainly in order to create specific emotions based on natural irregularities. The impression of the delicate structure of the petals for the creation of various and harmonically ondulated spaces, whilst at the same time producing dynamism and kinesis, in order to define a big space. It is important to translate elements adapted by nature with materials that trully emphasise them[2]. Botany, and more specifically phytology, the branch of biology that studies of plant life and development,

1 DEL CAMPO, Matias, Floral Obsession, lectures in ESARQ,, Universitat International de Catalunya, 20 February 2008.
2 Observations made by the author



ornaments cretated by nature.



ornaments cretated y human, inspired by nature.

botany covers a wide range of scientific researches concerning plants' disciplines, algae and fungi, as well as chemical properties and evolutionary relationships between the different groups.

Some of the basic principles of phytology have been chosen to be analysed:

<u>Venation,</u>

is the arrangement of the veins of a leaf. There are two subtypes of venation, craspedodromous, where the major veins stretch up to the margin of the leaf, and camptodromous, when major veins extend close to the margin, but bend before they intersect with the margin[3]. There are parallel-veined, parallel-ribbed, parallel-nerved, penniparallel — veins run parallel for the length of the leaf, from the base to the apex. Commissural veins, small veins, connect the major parallel veins, and also veins forking regularly by pairs.

<u>Plications,</u>

is the act or process of folding, or even the state of being folded.

Inflorescence,

is a group or cluster of flowers arranged on a stem that is composed of a main branch or a complicated arrangement of branches. It is the particular part of the shoot of seed plants where flowers are formed and modify it accordingly. The modifications can involve the length and the nature of the internodes and the phyllotaxis, as well as variations in the proportions, compressions, swellings, and reduction of main and secondary axes.

<u>Topology,</u>

comes from the Greek word τόπος, which means place, is the branch of mathematics that studies the properties of a space that are preserved under continuous deformations. Topology grew out of geometry, but unlike geometry, topology is not concerned with metric properties. Instead, topology consists of the study of properties that describes how a space is assembled, conjunction-wise and orientation-wise. Furthermore, it guides the processes of morphogenesis that generate many other geometrical forms.

<u>Ornament,</u>

Ornamental plants are typically grown for the display of their flowers. Other ornamental features are also considered to be leaves, scent, fruit, stem, bark, and thorns. In architecture, ornament is a decorative detail used over the centuries to embellish buildings on their interior or exterior. A wide variety of decorative styles and motifs have been developed for architecture and the applied arts, including ceramics, furniture, metalwork and textiles.

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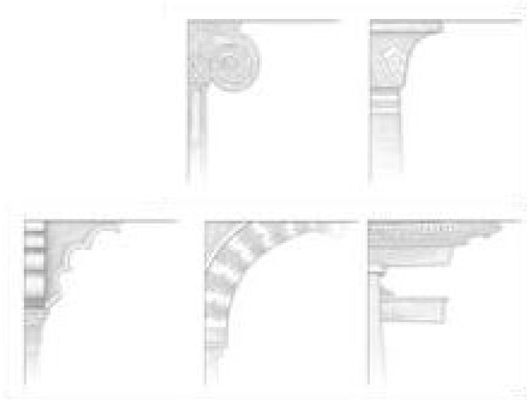
3 http://en.wikipedia.org/wiki/Leaf, 13 October 2008.



architectonic samples inspired by phytology.

The architectonic issues that are going to occupy us on phytology are the structure, the material and the form. The structure consists of two parts; one is of organization and the other of construction. It can be explored through biological phenomena such as tropism that indicates growth or turning movement of a plant, in response to an environmental stimulus. In physiology, a stimulus is a detectable change in the internal or external environment[4].

Throughout the 19th and 20th century, architecture concentrated on the homogenization of materials. Today the use of powerful computers provides us the possibility to experiment on heterogeneous material systems and composites, which can create more complexed constructions. Inspiration from botany provides possible solutions for new groups of material systems, as it treats material as a homogenous assortment of elements, an entity defined by form.

Software used to produce plants, or other organic models, also explores the habits in development of their species and cladistics. These creations can lead to the creation of architecture prototypes that include the spatial conditions found in botany. Through this process of research, the architect apart from comprehending the latter issues concerning contemporary architecture, he increases the design excellence and design expertise.

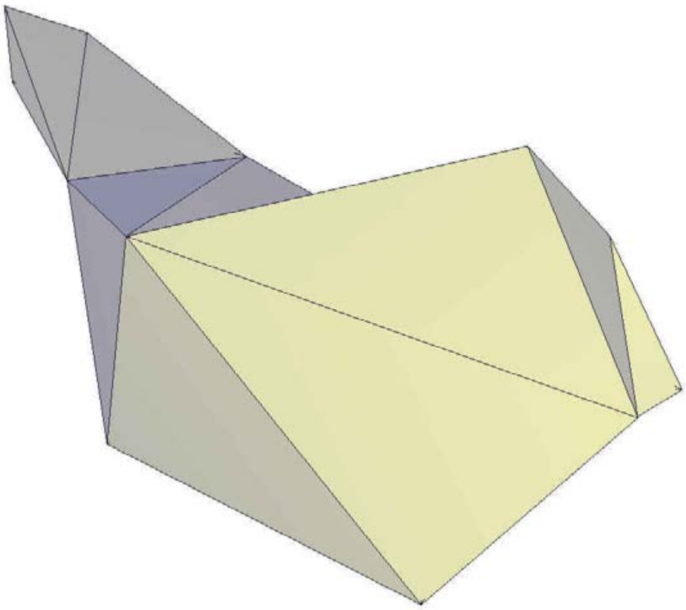
Through the use of genetic engineering the inherent condition of botany and the emergence of variation, are thoroughly being studied. The design is the foundation of modern genetics; a form is the idea of genetic engineering, the crossbreeding of design specimens, as well as issues such as mutation and cataclysmic emergence of processes histories of evolutions in short time, creating unexpected design results. Phenomena such as branching, phyllotaxis and tropisms are translated from botany into the toolbox of digital design and can provide starting points for the exploration of forms emerging from the field of the Botanical.

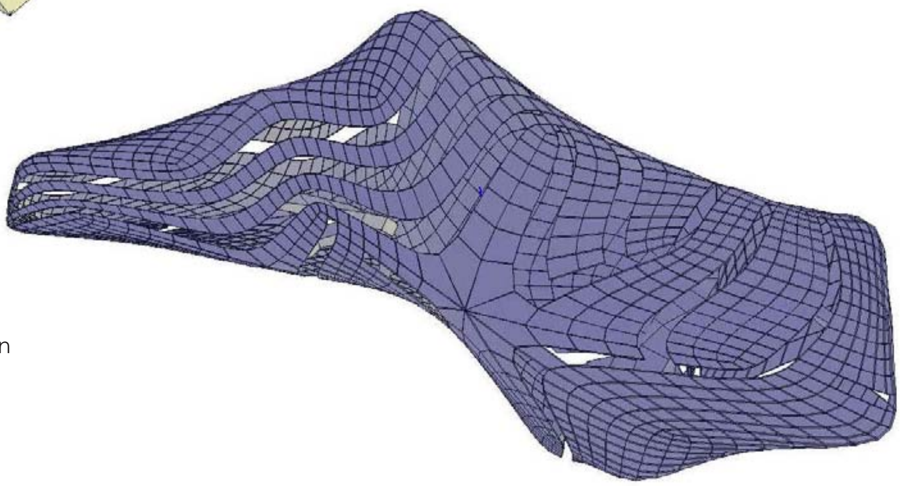
Architecture & emergence

Emergence is of tremendous importance to architecture. Its logic demands that we realise that buildings have a life span, sometimes of many decades, and that throughout that life they have to maintain complex energy and material systems. At the end of their life span they must be dissembled and the physical materials recycled. The environmental performance of buildings must also be rethought. Intelligent environmental behaviour of individual buildings and other artefacts can be much more effectively produced and maintained by the collective behaviour of distributed systems.

The power of swarm logic as an emergent behaviour is when the individual agents in the

4 http://en.wikipedia.org/wiki/Stimulus_(physiology), 13 October 2008.





TopMod experimentation

system pay attention to the immediate neighbours rather than wait for orders from above. They think locally and act locally, but their collective action produces local behaviour. Ignorance is useful[5], it's better to build a densely interconnected system with simple elements, and let the more sophisticated behaviour arise. Having individual components capable of directly assessing the overall state of the system can be a real liability in swarm logic.

An evolutionary architecture investigates fundamental form-generating processes in architecture, paralleling a wider scientific search for a theory of morphogenesis in the natural world. It proposes the model of nature as the generating force for architectural form. Architecture is considered as a form of artificial life creating architectural models, which respond to changing environments. The aim of an evolutionary architecture is to achieve in the built environment the symbiotic behaviour and balance that are found in the natural environment.

Therefore this concept can be extended onto any single individual building to its surrounding environment. Each building is part of an environment, which consists of abutted buildings and each individual should be the extension of data communication between the environmental systems and the neighbour buildings. Urban transport infrastructure, for example, must be organized to have similar environmental responsive systems, in order to arrange and manage the number of people onto streets and into buildings. Linking the response of infrastructure systems to groups of environmentally intelligent buildings will allow higher-level behaviour to emerge. The Nobel laureate Gerald Edelman[6] calls this process topobiology, as only with their local interaction can complex 'neighbourhoods' of cell types come into being, it is a totally decentralised process.

Process produces, elaborates and maintains the form or structure of biological organisms consisting of a complex series of exchanges between the organism and its environment. The organism has the capacity for maintaining its continuity and integrity by changing aspects of its behaviour. Those forms are related by morphogenetic tendencies and some of their characteristics are amenable to being modelled mathematically. Evidently, architecture and engineering have been preoccupied with such tendencies for generating designs of forms in physical and computational environments.

Topmod 3D prototyping machines

The computer simulation of evolutionary processes is already a well-established technique for the study of biological dynamics. Defining the relation between the virtual genes and determining how a gene spreads through a population over many generations. This is a task performed automatically by certain computer

5 Johnson, Steven, Emergence_the connected lives of ants, brains, cities, and software, Scribner, New York, 2001, p. 73-163.
6 See, EDELMAN, Gerald, Topobiology: An Introduction to Molecular Embryology, Basic Books, New York, 1988, p. 9-58.

Rapid prototypes and mould of material for the construction in real scale, Sagrada Familia, 2008.

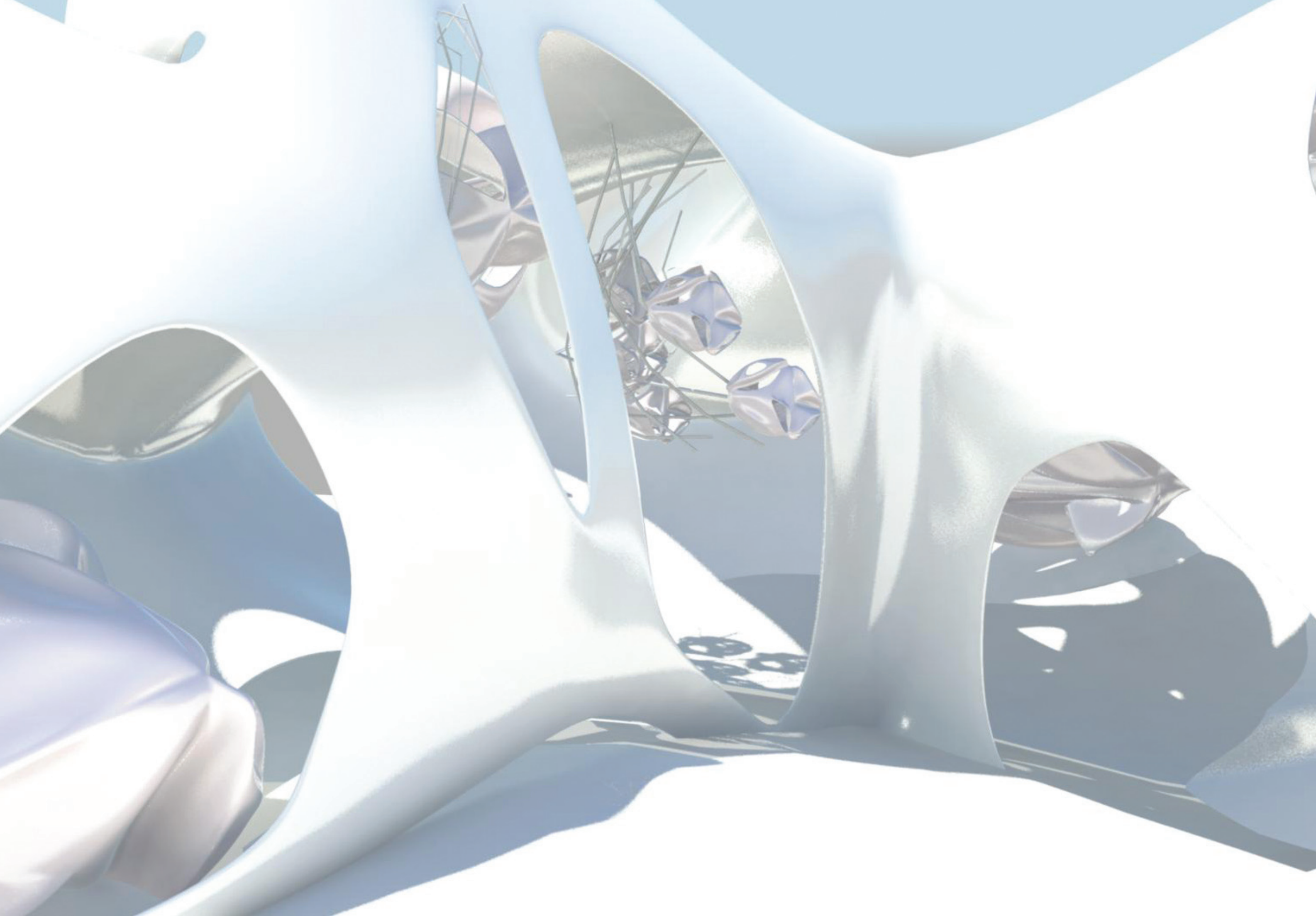
programs collectively known as 'genetic algorithms'. The functional properties of this type of software create techniques used for applications as aids in artistic design TopMod is a programme based on a new paradigm that allows dynamically change in the topology of 2-manifold polygonal meshes[7]. The new paradigm always guarantees topological consistency of polygonal meshes. By simply adding and deleting edges, handles can be created and deleted, holes can be opened or closed, polygonal meshes can be connected or disconnected. These edge insertion and edge deletion operations are highly consistent with subdivision algorithms. In particular, these operations can easily be included into a subdivision modelling system such that the topological changes and subdivision operations can be performed alternatively during model construction. TopMod demonstrates practical examples of topology changes based on this new paradigm and show that the new paradigm is convenient, effective, efficient, and friendly to subdivision surfaces. With the introduction of subdivision surfaces and the wider usage of solid modelling and implicit surfaces, topology has been becoming an important element of computer-graphics research, development and production. There have been various studies in topological modelling during the last decade.

New technologies widely available such as 3D prototyping laser cutting and CNC enable for the rapid release of innovative designs, during the testing of real physical material allowances to later stages of projects. Tests such as these make it possible to reveal unknown modes of structural and material behaviour that digital models have constructed according to node patterns and parameters. It is an unprecedented link of abstract, digital and real, physical and material. They allow us to create approximations of geometry by controlling variations on materials, and allow for the measurement of performance. Such programmes cooperating with CNC machines are being used now Spain, for the building of the Sagrada Familia, in order to test the structure's strength. A virtual building will not evolve as a building unless the architect brings into a CAD model the intensive elements of structural engineering, distributions of stress. An architect should be prepared to use virtual evolution as a design tool without being under the delusion that the only role left for him to do is to judge the aesthetic result in every generation. In order to link ornamental and structural elements the architect is expected to make design decisions and be extremely creative in order to complete the model. This is a very serious matter in the design process where one can develop a unique style.

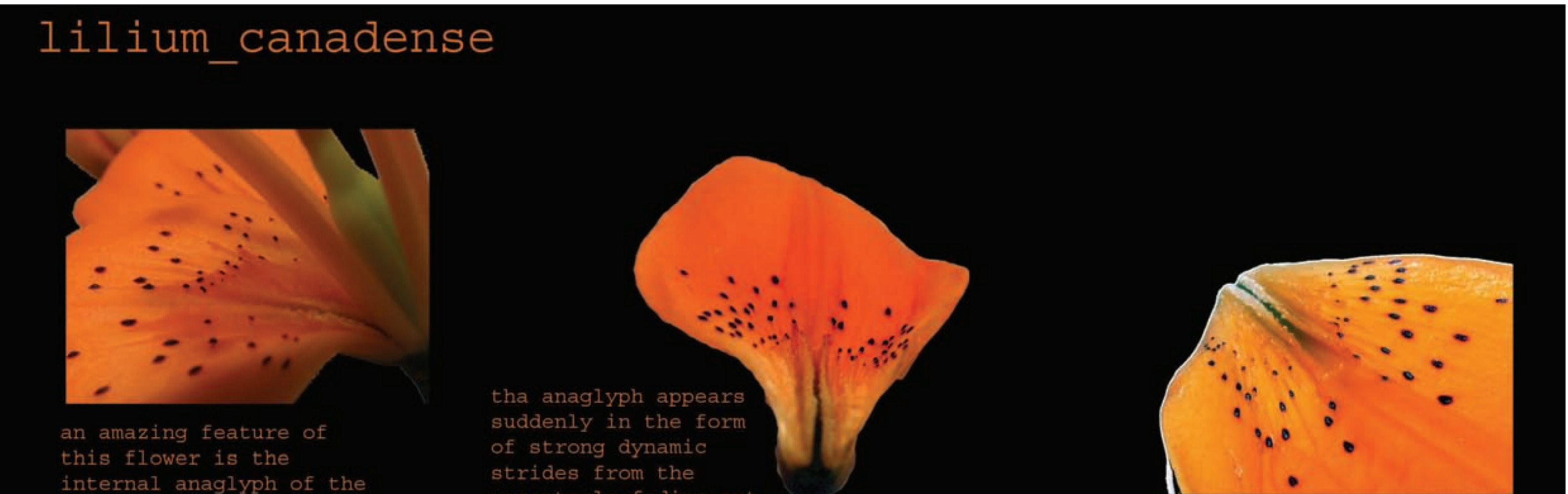
Genetic Architecture of developmental processes

A comprehensive model based on phenotypic variation and evolution needs to be incorporated by three different biological processes, allometry, ontogeny and plasticity. Each

7 http://www.topmod3d.org/, 20 February 2008.



an architectural space proposal from the study of the lilium canadense



of them involves complicated machineries that relate the genotype and the phenotype.

In that case of allometry, it determines the coordination and function of various parts of an organism. Ontogeny concerns a series of developmental changes of an organism, for example from a fertilised egg to an adult. This process is essential for the organism to live and reproduce.

These three aspects of biology help to gain insights into the control and regulation mechanisms of growth, development, and adaptation. They help us understand the phenotypic variation and evolution in different ways. As they provide synthetic analyses of biological information from different elements through mathematical modelling. The integration between ontogeny and allometry can be powerful in characterising developmental changes of overall morphology, structure, and function of an organism. As evolution is the transformation of adult morphologies; evolution should be regarded precisely as the modification of developmental, embryonic, ontogeny.[∫] By concentrating on the issues of cell creation and cladistics in genetic engineering, the architect establishes a design strategy through the thorough study of various approaches in botany entities.

Conclusion

The aim therefore is not to mimic the structure and form, colour variation, and just apply it where desired. The innumerable expression of form can result in various spatial conditions ready to be explored, as a performative surface as well as for the economy of form. This performance process that we have studied from nature should be carefully programmed and located into the adequate software as to obtain solutions for various architectonical matters. Software programs are truly powerful, as by using them, an architect can create any form he desires and transform its space as he wishes. Always abstracting a different result-form.

In the task of designing rich search fields, certain philosophical ideas can be traced in the work of Gilles Deleuze. The three forms of philosophical thinking, populational, the intensive, and the topological. This has made the basis for a brand new conception of the genesis of form; A given animal or plant structure evolves slowly as genes propagate in a population, at different rates and at different times, so that the new form is slowly synthesised within the larger reproductive community. Population thinking in its present form is derived from thermodynamics. The intensive thinking is the modern definition of an intensive quantity given by contrast with its opposite, an extensive quantity. Finally the topological thinking makes us realise the results that architects have so far obtained with the genetic algorithm, and the results achieved by biological evolution.

“Difference is not diversity. Diversity is given, but difference is that by which the given is given...Difference is not phenomenon but the nuomenon closest to the phenomenon... Every phenomenon refers to an inequality by which it is conditioned...Everything which happens and everything which appears is correlated with orders of differences: differences of level, temperature, pressure, tension, potential, difference of intensity”[8].

This phenomenon that digital technology offers us to breed buildings through computation, consequently demands acknowledgement of biology, thermodynamics, mathematics, and other areas of science that can offer necessary resources, as they can prove to be necessary and particularly helpful. Many phenomena, in geology, meteorology, biology and even economics and sociology, emerge spontaneously from the interplay of intensity differences. Indeed, one can build an entire theory of the genesis of form, be that geological, biological or cultural forms, on the basis of processes of becoming driven by intensity differences. As a principle, actualization or differentiation is always a genuine creation.

8 Deleuze, Gilles, Difference and Repetition, Columbia University Press, New York, 1994, p. 222.