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Department of Postgraduate Studies

CONSTRUCTED IMAGES
Artistic imagination and scientific visualization

1. THE RESEARCH TOPIC

We often face nature through our senses: the world feels, smells, tastes and looks. We are accustomed to thinking that our image of nature is formed precisely in this way, through perception, through the senses; impinging upon our retinas. In our culture, depictions of nature are often based on this visual perception of the world.

1.1 The perceived forms of nature

The depiction of nature based on visual perception most often uses mimetic imitation as its means. We may reduce and simplify the form of the subject being depicted, but in one way or another we try to imitate what we see with our eyes. An example of this way of depicting nature could be a prehistoric rock painting representing an animal. Ancient painting thus represents its subject, namely the animal, in the form of a simplified visual imitation.

In our human culture, however, there is also another tradition of depicting nature, a way whose history may be as long as the history of depicting that which is visible. Apart from experiencing nature through the ages with senses and emotions, people have also contemplated and studied its deeper essence and structure. Human beings have always used the help of the image in studying and gathering information about the world surrounding us.

1.2 The constructed forms of nature

This other mode of depicting nature is fundamentally different to the first one. Images formed through science and related information do not always try to imitate visible nature. They seek to illustrate things by creating an image having some kind of internal structure corresponding to the object being depicted. To take an example from prehistory, we can imagine an ancient animal bone with a row of 30 small notches cut into its edge.

We see how such a structure could have served as a depiction of nature: small notches correspond to days with the entire bone representing a whole month, the period in which the moon visible in the sky first waxes to its full glory, then wanes and starts the cycle all over again. A bone notched in this way might have formed an image of time invented by a prehistoric man, an image of a natural phenomenon that can be understood, but cannot be depicted just by replicating what is visible.

Thus, I differentiate these two ways of depicting nature from each other by calling the first mode a “depiction of perceived forms of nature”, and the latter “a depiction of constructed forms of nature”.

The depiction of constructed forms of nature has developed− in particular within the context of the scientific research of last two centuries − into its own field called “scientific visualization”. Despite the growing importance of visualization and its recent technological developments, it has its roots deep in the history of human culture. The means to describe nature and to visualize science and information in general reach way back in time. People have often made use of forms and structures that, throughout the different ages, have proven to be an effective means of depicting a great variety of things. Such structures – or constructed forms of nature – often used in visualizations are different grid patterns and branching tree-like diagrams.

1.3 The grid

The grid as its own subject matter can already be found beginning with the cave paintings of Lascaux. Early cultures in the Middle East took notice of the efficiency of the grid in their constructions, from laying uniform bricks all the way to organizing the structure of an entire city. The first grid plans of cities were created.

The grid has served as a powerful tool for organizing information through the centuries. With its help, people have measured and determined the location of places, for example on geographical maps. The grid has also been used in depicting more abstract things. The idea of a rectangular mathematical coordinate system as published in 1637 by René Descartes was also partly of assistance in starting a new era in modern science. The idea of presenting statistical information with a curve on a rectangular coordinate grid, published in 1786, is the invention of Scottish engineer and political economist William Playfair.

1.4 The branching structure

Family relationships have been represented with a tree-like branching structure from about AD 1000 onwards. Images represented the pedigree of Jesus descending from Jesse, father of King David, thus giving the image the name “Tree of Jesse”. These sometimes greatly simplified figures depicting Jesus’ descent from Jesse through a direct paternal line was common subject matter in medieval manuscripts and glass paintings.

Gradually, nobles started to represent their own pedigrees with similar tree-like diagrams, thus establishing the tradition of the visual family tree. In science, the idea of a family tree gained particularly great significance in 1859 when Charles Darwin published his famous book on the origin of species, in which he introduced the idea of different species evolving from previous species, and in which he illustrated the idea with a tree-like diagram.

Nowadays, it is difficult to imagine a world in which information would not be presented in a visual fashion. It may be easy for us to accept the idea that certain issues belonging to our culture can be illustrated with the help of visual structures, but how is it possible that these very same structures are also often effective in our efforts to describe the laws of nature, which are completely independent of humans?

2. THE RESEARCH QUESTION

Throughout the course of its development, our human culture has depicted both perceived and constructed forms of nature in great numbers. In my studies, I am interested in the question of whether these two modes of depiction are mutually exclusive, or whether they instead share a mutual language of forms. Where do the language and structures of the constructed mode of depiction come from? Do some artificial basic forms and structures created by human concepts and cognition exist, or do these also come about in one way or another directly from nature?

3. PARTS OF THE RESEARCH

3.1 The written part

The starting point for the written part of my research is to address the relationship between perceived and constructed forms of nature. From the constructed forms of nature, I have selected the grid and the branching structure to be investigated in my study. With the help of these two structures, I will try to discuss where the line between perceived and constructed forms of nature could be drawn, or whether it is even possible to define such a distinction.

Scientific visualizations with their constructed forms are always designed to present information. In the written part, my objective is also to discuss how the concept of form inherently relates to the concept of information. The Latin word meaning “form” – *"forma"*– refers to a mould, and the word “information” derives from the Latin verb *"informare"*, which in turn has meanings such as "give shape to, fashion, describe”.

Art history includes form and gestalt theories, which have been used to analyze visual structures in general, and works of art in particular. Theories related to modern art in particular contain basic forms such as the circle, square and triangle. In the written part, I am also interested –within my possibilities– in examining any connections that might exist between scientific visualization and the history of art.

Hex Rosa

The written part of my research will include a presentation of a certain geometric system developed by me. I will call this system *Hex Rosa* in totality. With good reasons one can say that this pattern –or in more general sense structure / system– stands between art and science.

The starting point for this system has been an infinite division of the plane found by British physicist Sir Roger Penrose in 1970’s that has some remarkable mathematical properties. The system found by Penrose was one of the first regular and repetitive but *aperiodic* geometrical structures that mathematicians were able to construct. It was also the very first aperiodic structure which was not based in square. What makes the Penrose structure so remarkable is the repeating 5-fold symmetry in holds, for this kind of property was considered impossible before.

It was no wonder that this discovery aroused the attention of the mathematicians in late 70’s but the real sensation happened in 1984 when Israeli chemist Dan Schechtman told that he had founded similar kind of structure from the crystals of real physical matter. The discovery of Schechtman was against the very basics of the crystallography for 5-fold symmertical crystals should not have existeg even in theory. In the beginning Schechtman had to face doubts and even ridicule from his colleagues but clear evidence and perceptions could not be ignored. Eventually the very crystallography itself describing the structure of solid matter had to be rewritten to hold not only classical crystal structures but also the new aperiodic *quasicrystals*. Eventually Dan Schechtman was awarded the 2011 Nobel Price for Chemistry for the discovery of the quasicrystals.

The Hex Rosa structure developed by me got its start from the quest to find a certain kind of ”generalization” for the Penrose structure. If the Penrose structure were thoroughly 5-symmetric would it be possible to construct some kind of repeating structure holding infinitely 7-symmetries or 9,11,13, etc. symmetries? My desk

drawer had collected a substantial amount of material in relation to this kind of structures but it was not until in the end of 2011 along the news of Dan Schechtman's Nobel Prize I realized how this material was actually something very relevant for the topic of constructed and perceived forms in my research.

I understood how the structure of Penrose was a beautiful example how a constructed, abstract mathematical form / structure is directly perceived in nature. We have an example of a type of scientific discovery: a culturally constructed structure is perceived in nature. A same kind of process can also be performed in other direction when a phenomenon perceived in nature is given a culturally constructed form. In this case we have an example of a type of scientific visualization.

In interesting way this structure brings to light the question about the relationship of imagination and creativity and the structures of nature. Does it matter how some form of structure depicting nature has been invented? What is the role of personal interest and creativity of a human? Can we say we personally invent or construct structures related to nature, or are we merely accidental discoverers of these?

In my opinion the Hex Rosa system –developed by me– gives exactly *one's own* point of view for these meditations. It makes a new level compared if I would use as an examples in my book only geometrical "basic forms" such as square grid and branching tree structure. In my opinion to the doctoral thesis of visual arts fits excellently precisely a *visual* representation that crystalizes the central problematic of the research.

I shall mention here that the Hex Rosa system I am talking about *is not* aperiodic like the Penrose structure is. As far as I understand nobody has so far been able to present aperiodic structure with 7-fold symmetry. I shall also mention how by coincidence one central element of the Hex Rosa system (with larger values than n=7) resembles somewhat a geometrical pattern that Michelangelo designed to cover the Piazza del Campidoglio Square in Rome. Popes nevertheless interpreted the pattern by Michelangelo referring more to neoplatonic than Christian themes and the paving was realized only at the time of Mussolini in 1940's.

3.2. Written part in relation to the part on artistic production

As an artist and a painter, I reflect these questions on perceived and constructed forms in my works and often mix the elements of these two in my paintings. I try to create a space in my works in which a meaningful dialogue can emerge between the constructed (information) and the artistic (form). The starting point for my paintings is often a subject matter related to perceived nature or scientific visualization, the structure of which I start to re-form according to the rules I detect in the image under consideration. Even though my works do not produce new scientific visualizations at a practical level, they are presentations of processes that use artistic imagination, processes through which all human-produced depictions and visualizations of nature are ultimately formed.

The subjects of my paintings are not necessarily the grid or the branching structure on a visual level *per se*. I am interested in the question of how the motifs depicting perceived and constructed forms of nature are usually demarcated. How do we recognize an image representing a quality connected to perceivable nature, whether it is a structure of a plant, spatiality or the representation of a shape? How do the means of such representation relate to the means of the representation of

constructed forms of nature in scientific visualization where structures, spatiality and shapes are also depicted?

Where do the boundaries for the depiction of visual information ultimately end? What if the representation has been stripped of its actual scientific content and just the structure, form and mould of the representation are left? If such empty moulds do indeed exist − devoid of the information contained − is it possible to touch these empty “information moulds” of nature with the means of painting?

3.3 The artistic production part

The artistic production part of my degree will consist of a single curated group exhibition and two solo exhibitions.

The exhibition at the beginning of 2008
11.1. - 3.2.2008 in Forum Box, Helsinki. A group exhibition that I curated called "uusi-luonto-tieto” (new-nature-knowledge) was held. The theme of the exhibition was nature and science. The artists taking part in the exhibition each presented their own independent works. The artists in the group were Antti Immonen, Tuula Närhinen, Mikko Rantanen and Markus Rissanen. An exhibition catalogue in Finnish was published for the occasion.

The exhibition at the beginning of 2009
In January 2009, the first solo exhibition to be included in my degree took place in Galleria Heino, Helsinki.

The exhibition at the beginning of 2013
In January 2013, the second solo exhibition to be included in my degree will take place in Galleria Heino, Helsinki. There is a goal to publish – if possible – a publication larger than the usual small exhibition catalogue about the author's production. The written part of my doctoral demonstration of knowledge and skill will be left for pre-evaluation either on this occasion or later.

3.4 An international symposium *Order of Nature or Matrix of Man?* held October 15th, 2010 at the Finnish Academy of Fine Arts. Speakers of the symposium were Markus Rissanen, Hannah Higgins (USA), Tarja Knuuttila, Christoph Fink (Belg.) and Joao Figueira (Portg.).

4. RESEARCH SUPERVISOR

Main supervisor: artist Jan Svenungsson (Berlin), Professor at the University of Applied Arts, Vienna (2011).

Additional supervisor: Professor Riikka Stewen, Academy of Fine Arts, Helsinki