The Effect of a Butterfly upon an Opus of Architecture

– A Catastrophe Theoretical Perspective upon Design Theory

by Ole Møystad

Tema DESIGNTEORI

LET US START BY CONSIDERING ARCHITECTURE as the form which is generated by the confrontation between the forces of physics and those of thought.

Then, let us establish the strata by which this form becomes manifest. Let us refer to the singular, local piece of architecture, the individual physical entity, as the Object of Architecture, ObA. The general global level of architecture, our architectural environment, I will suggest to understand as a field. That is to say that I will refer to that area of the world where the force dynamics[1] between physics and thought unfold as the Field of Architecture, FoA. Between these two strata we must establish a third level as an access to the previous two lewels; representing the level on which we use and produce architecture. Let us call this stratum of interaction and comprehension the Opus of Architecture, OpA.

As architecture belongs both to physics, as ObA, and to thought, as FoA, to matter and to mind, a knowledge of architecture, as OpA, has to comprise and connect the two. ObA will be an entity whose extension is basically spatial, and it will roughly correspond to 'architecture's second mode of being'.[2] FoA can, on the other hand, not be said to have any other extension than a temporal one. It will roughly correspond to 'architecture's first mode of being'. Together ObA and FoA will constitute a *virtual* space-time continuum. By providing an access to this continuum, or rather to one particular piece of it, we can say that an OpA is an *actualisation* of a certain amount of architectonic space-time. OpA will roughly correspond to 'architecture's third mode of being'.

Ole Møystad, architect MNAL
Free-lance practice in Oslo

Towards this backdrop the claim of Pérez-Gómez that "Architecture is a verb" becomes meaningful.[3] As architecture is a space-time entity, the knowledge of it must in the least account for the span of space-time that OpA actualises.

A topology of architectonic knowledge can be understood as the form, or regularity, according to which architecture unfolds; from conception to design, to construction, use[4], decay, demolition and memory. To the extent that architectonic knowledge is possible, it hence relates 'mind' and 'physics', or subject and object if one prefers, and it does so adopting both 'time' and 'space' as parameters. The topic of this paper is therefore located in the interface between architect – engineer, client and user. I will be referring to this as 'the OpA interface'.

One is used to give technical and economical performance specifications of a project. This is quite normally required, and there are well established methods available for making such specifications. Recently, however, public authorities as well as potential clients have started to require architects to submit performance specifications also concerning aesthetical and other hardly quantifiable properties of a project – before the contract is signed or permission is issued[5]. Architects are hence faced with the problem of giving a reasonably precise *conceptual* outline of OpA, so precise that it can be subjected to meaningful evaluation by client, constructor, user and/or public authorities – *before* singularizing the qualities in an actual project. Conjunction between architecture's material aspects and its cognitive, cultural aspects is in fact made pragmatically every time something is built; the only novelty is that the architect is asked to account publicly for his act. It seems a reasonable request, and it seems reasonable to expect of a theory of architectural design that it contributes to this account.

There are three aspects to the making up of the account. First there is the problem of producing the conceptual outline of OpA, all qualities included. Then there is the problem of actualization, of producing one particular physical object[6] which meets the promises given in the conceptual outline. These are both complex and important problems to study. A precondition for solving them is, however, that there is some kind of a connection, or channel, or passage between the two, between architecture's being as thought, and its being as object. This paper is intended to give a suggestion as to the description of that passage.

Method

In the outline of the topic I introduced the concept of a passage between architecture's first and second modes of being.[7] In terms of a phenomenology taking interest in architecture as a problem of presence, of being-in-the-world, the first mode of being would actually correspond to a not being; the problem of absence so to speak.

Only in the case of the second mode of being we would be having to do with being. In strict phenomenological terms our topic would in other words be architecture's leap from not-being to being. In an other terminology this leap is referred to as *creation*, and not even theology seems to have been able to account very accurately for that act.

I have tried to de-deify the act by presupposing that what goes into a house, ObA, is not brought into the world by a divine creator. It may initially have been, but then at such space-time distance from our scenario that it must be held as irrelevant to a contemporary theory of architectural design. For what can be classified as methodological reasons, I have presupposed that whatever goes into ObA is already virtually there; within FoA. When the thought of an ObA enters the space-time of OpA, it is actualized as architecture in its first mode of being. When the rain and the brick, or the overhanging cliffs in the Vézère Valley, enter OpA, they are actualized as architecture in its second mode of being. What I am suggesting with the introduction of a third mode of being is that architecture does not lapse into being if only a sufficiently inspired architect thinks about a house while holding a brick in his hand. Even a genial architect has to put down some labour in making a house from brick and thought. Furthermore it takes labour for the user to obtain shelter, pleasure, comfort, rest, inspiration and whatever else we require even from a beautifully arranged heap of bricks in order to accept it as architecture. An ObA *ex nihilo* does not provide any of these things. It is not until a building is perceived and experienced in the context of the OpA interface that the quality 'architecture' can unfold. Architecture's third mode of being hence concerns architecture from conception to use; architecture's third mode of being is actually architecture's *becoming*.

The introduction of this concept presupposes that it takes time to bring architecture from not-being to being; that there is a certain space-time between 0 and 1. This presupposition implies that the space-time in question is not some black spot in the being of architecture, but on the contrary that it is an essential property of architecture. This may seem banal, but every modern, that is to say digital, computation is based upon the opposite principle. Even experimental analogue computation in studies of artificial intelligence is conducted on digital computers simulating analogy.

Architecture does not pertain to the world as given, or let us say to nature. It is a design product; like an artificial neural network is a design product. If, therefore, architecture in fact does hold the gradual unfolding of a space-time between 0 and 1, or between not-being and being, as one of its basic properties, this movement should somehow be describable as a morphogenetic process.

Morphogenetic processes, in general, in whatever field form occurs and unfolds, is studied by Catastrophe Theory (CT). I have therefore paid some interest to CT, in the hope of coming closer to an

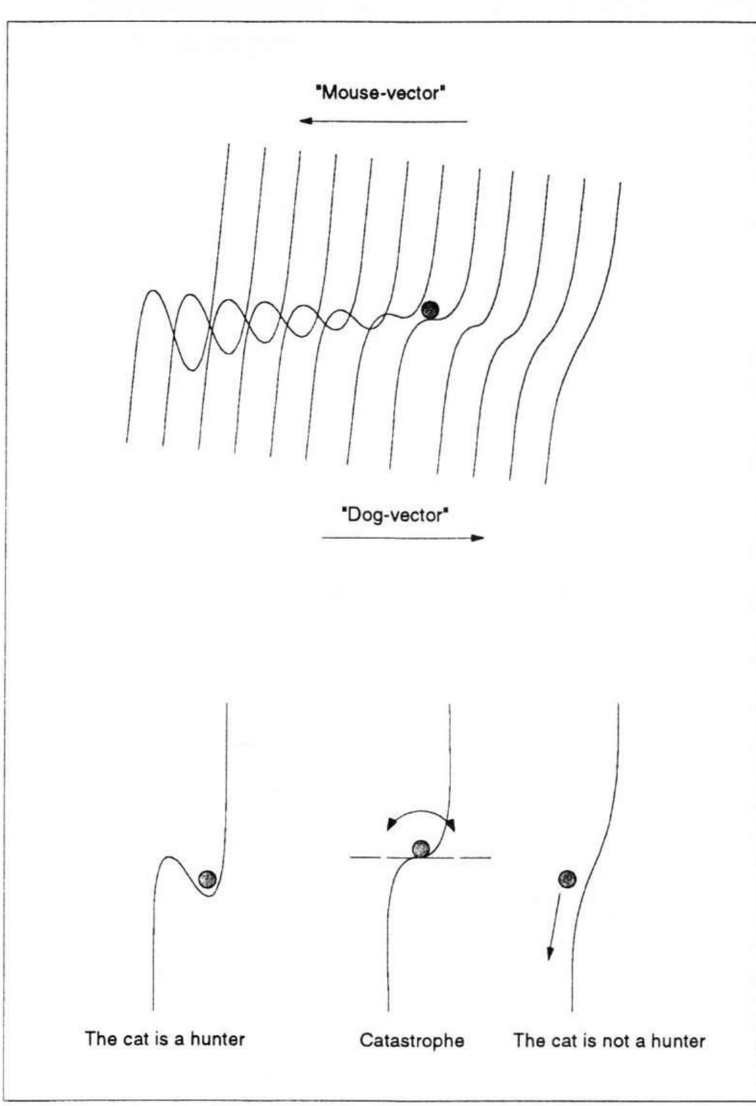


Figure 1. A cat's change between hunter and not-hunter illustrated on the uni-parametric catastrophe called "The Fold".

understanding of morphogenesis within architecture. Before we proceed to try CT-models on the formation of architecture, I will give a (very) brief introduction to the theory.

The most concise outline of Catastrophe Theory to my knowledge, is given by Zeeman: "It is a scientific manner by which we can make models of phenomena where a continuos cause produces a discontinuous effect."[8] Zeeman gives as example the gradually proceeding inclination of a ship causing it at one point to turn abruptly over and sink. Given FoA as our context, the continuous cause would be OpA, and ObA would be the discontinuous effect.

" I would say that above all it (Catastrophe Theory) is a methodology[9]" René Thom holds that the object of any science can be inscribed in a spatio-temporal phenomenology. In his early works he studied topological theory in mathematics. He started however, to

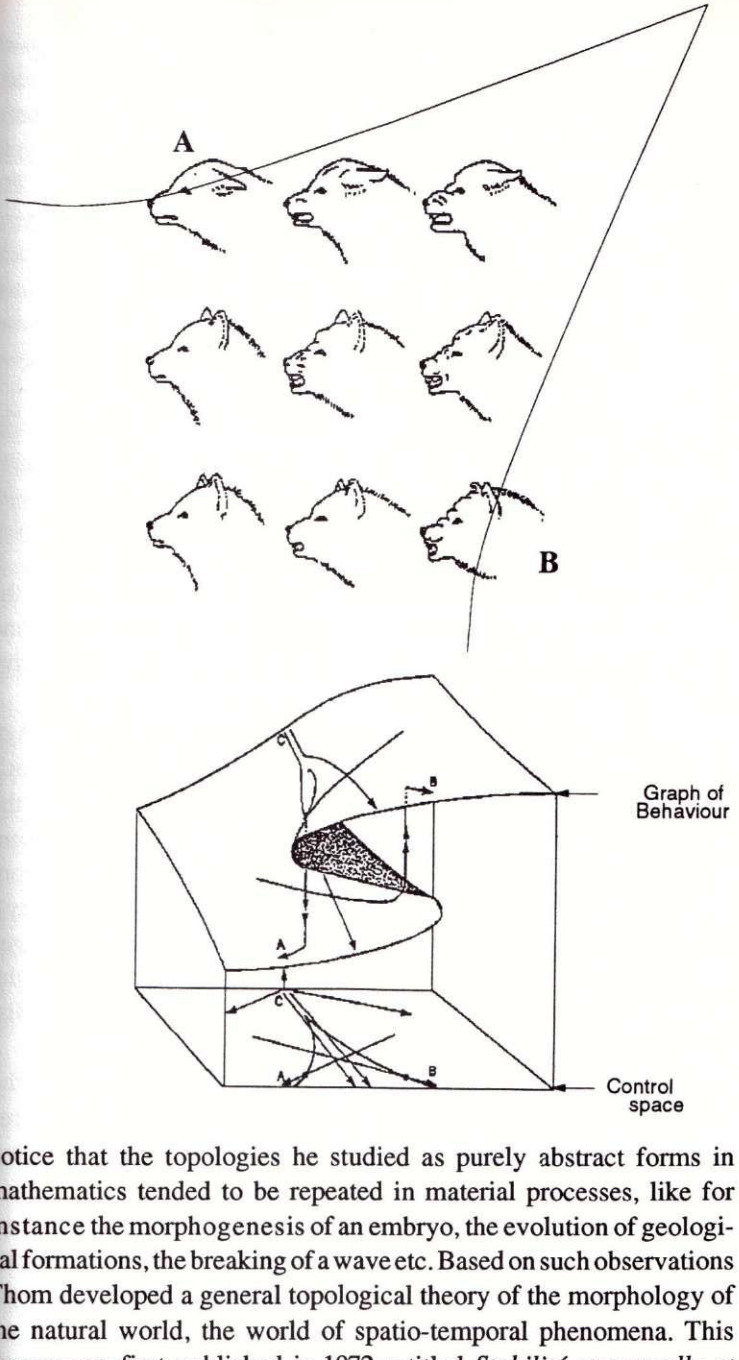


Figure 2. Zeeman's analysis of a dog's Aggression. The upper graph is called "The Graph of Comportment", and the lower graph is referred to as the "Control space". Point A represents the catastrophe of escape, the point where the dog definitely becomes prey. Point B represents the catastrophe of attack, where the dog definitely becomes hunter.

notice that the topologies he studied as purely abstract forms in mathematics tended to be repeated in material processes, like for instance the morphogenesis of an embryo, the evolution of geological formations, the breaking of a wave etc. Based on such observations Thom developed a general topological theory of the morphology of the natural world, the world of spatio-temporal phenomena. This theory was first published in 1972 entitled *Stabilité structurelle et morphogenèse*.[10]

I will try to avoid venturing into the mathematical jargon of CT. For our purposes it suffices to understand the underlying logic and the schematics of the method. As a matter of fact, once one is able to surpass the somewhat forbidding mathematical jargon of CT, an architect will soon recognize a way of thinking by means of schematizations and graphic representations that combine apparently incompatible

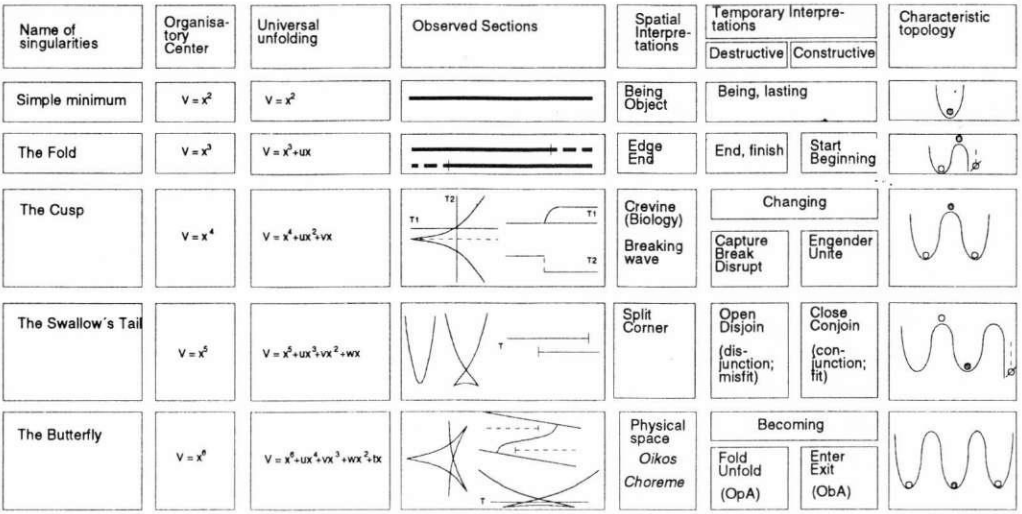


Figure 3. The List of the four most commonly referred to of the Elementary Catastrophes according to René Thom.

parameters. As such, the method has very much in common with the way any architect works when he combines construction details and functional diagrams with general lay-out plans and associative sketches, all in one drawing.

The term "Catastrophe" refers to the point at which one form or condition lapses into another. A classical example of this is a cat's change from hunter into prey. In its most elementary version the catastrophe represents the change from hunter to not-hunter or from prey to not-prey separately. This can be done on a scale running from position, $p > 0$ (hunter – or prey) to $p < 0$ (not-hunter – or not-prey). See fig. 1. If we would represent both the prey and the hunter changes on one graph, we would have a bi-parametric catastrophe called "the Cusp". This type is shown in fig. 2 as applied in a classical analysis, by Zeeman, of the aggression of a dog.[11]

CT is, in other words, on the one hand a mathematization of the form which is generated. On the other hand, it is a method of representing qualitative changes graphically, and hence trying to open new possibilities for a theory of realistic meaning.[12]

The actual change of the cat in our example is, in CT terms, an "inner" space to which the numeric scale provides an "outer" space of referential variables. One of Thom's basic discoveries is that all possible changes in "inner" space can be described by seven strata of archetypal C-value in the "outer" space. These seven "archetypes" are called "elementary catastrophes"[13], see fig. 3.

As must be expected when introducing such an unorthodox and interdisciplinary theory, it evoked a lot of criticism. In order to be accepted within a traditional mathematical paradigm, the theory should be purely mathematical. It should prove its mathematical theorem on the basis of certain axioms, and that should be all. It should not, as CT in fact does, interfere with the world of phenomena.

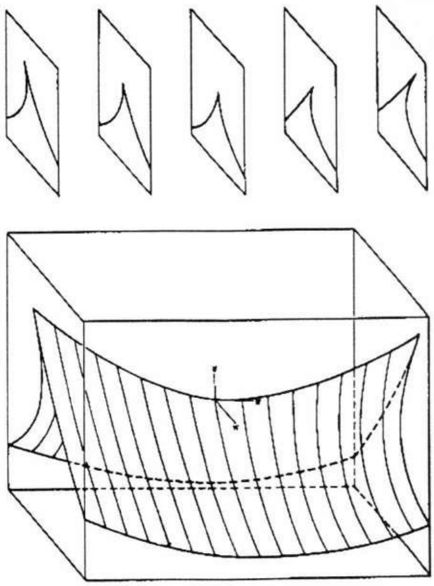
In order to be accepted by physics, it should be testable by experiments. Thom's collaborator, Zeeman, claimed that CT could produce models by which it was possible to predict, with mathematical precision, the evolution of a morphogenesis, like the change of our cat. Zeeman thus attracted much criticism towards CT. Thom was, however, among the first to criticize Zeeman's claim.[14] There are of course too many uncontrollable variables to be able to predict how much dog it would take to turn a hunter cat into a not-hunter cat; in other words to make the particular cat in question forget about the mouse and fly from the dog.

This does not, however, mean that the graphic representation of the catastrophic change is not valid as a scheme, and the criticism on mathematical grounds does not indicate that the schemes are not mathematically correct or precise – as such. These objections are only reminders that the CT scheme, as any scheme or model, relates iconically to the particular case, not indexically as Zeeman would have it.[15]

The entire typology consists of seven types with a complexity of one to four dimensions. Fig. 3 shows the four that are of interest in the present connection. It has been held[16] that the theorem of the seven catastrophes is a far too restricted basis for CT's claim of a general analysis of morphogenesis. Thom[17] responds to this objection by pointing out that the validity of CT does not depend on the seven elementary catastrophes. He holds, on the contrary, that it is necessary to exploit all the resources of the theory of bifurcations, which can be accomplished quite irrespectively of the general validity of that theorem. The basic principle of the mathematical schematization of a morphogenetic process organizing a structure with one or more catastrophic points, does not have to be erratic even if Thom's typology of catastrophes was demonstrated to be so (which it to my knowledge has not been hitherto). The basic issue is, after all, the study of the nature of generic bifurcations, or in other words the identification of bifurcations that are structurally stable, which means that they happen more or less in the same way every time; as in for instance an embryo, a wave, a cat, or in our case – in architecture.

I will spare my reader further details of this discussion[18], and proceed to the introduction of the two kinds of elementary catastrophes that I will be applying, namely the 'Cusp', and the 'Butterfly'.

i) The Cusp has three parameters and organizes two catastrophic points (C-points). The classical example of an applied Cusp is Zeeman's model of a dog's aggression. The graph, see fig. 2, which shows the actual pattern of behaviour of the dog, is called the "inner" space. The space of reference (*L'éspace de contrôle*), the projection of the Cusp, corresponds to the "outer" space. The three dimensions, or parameters, are in this case fear, rage, and behaviour. The two C-points, or catastrophic changes, or bifurcations, are the attack and the escape.



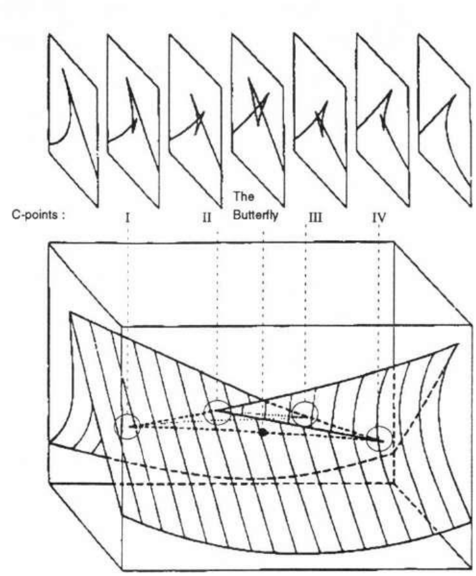


Figure 4a. The Butterfly at t > 0 according to René Thom 1989.

Figure 4b. The Butterfly at t < 0 according to René Thom 1989. Above it are shown the sections of the hypersurface as its ends, at the four C-points, and at the Butterflypoint.

ii) The Butterfly has six parameters and organizes four C-points. See fig. 4b. The Butterfly can be described as the transition of one Cuspoïd kind of singularity via the "Butterfly-point" into another Cuspoïd kind of singularity in the course of time.[19] Thom describes this transition with a three-dimensional hyper surface presupposing the fourth dimension, time, to be a constant.[20] That is to say that in the spatio-temporal phenomenology of Thom, time, T, as a general parametre is considered as a constant. Let us say $T = 1$. The local time, t, of one particular phenomenon can, on the other hand, pass at a higher, lower, or equal velocity than the constant, T. We do in other words basically have three temporal conditions: $t/T > 0$, $t/T = 0$ and $t/T < 0$. Given that $T = 1$, these three conditions imply $t > 0$, $t = 0$ and $t < 0$ respectively. These three t-values are henceforth used to represent the three temporal conditions. In order to illustrate the concept of t value, let us imagine our space-time continuum as a river with a boat on it.

The water flows at a constant velocity. In order to escape associations to subject-object relations, let us refer to the boat as the *topos* of experience, the point where time and phenomena meet. At $t = 0$ the boat moves at the same velocity as the water. Now; let us think of the movement of the water, as the flow of phenomena, and of the movement of the boat as local, or phenomenological, or experienced time, t. At $t = 0$ time and phenomena are in equilibrium, all times meet all phenomena. We have a temporal simultaneity where everything *can virtually* happen, but *actually* nothing happens. It is hard to give a concrete example of this condition, because it is per definition a condition which only exists as a theoretical entity, like certain mathematical phenomena. We can imagine + 1 apple and -1 apple, but 1/0 apple is phenomenologically impossible.

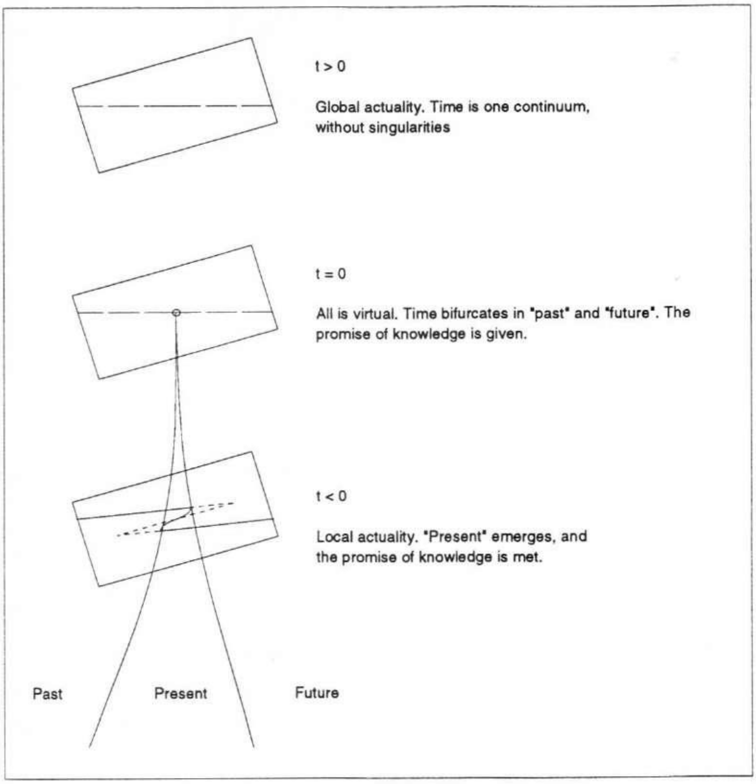
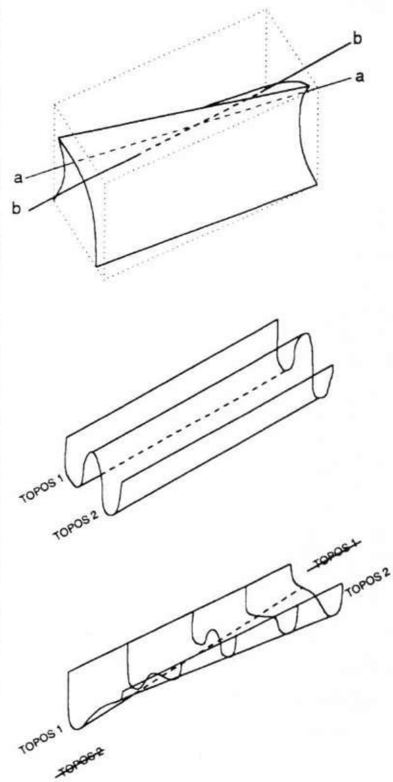


Figure 5. Scheme of the Butterfly at t values t > o, t = 0 and t < 0. Corresponding creodes as generated by the characteristic topologies involved are indicated in figures 6 and 7.

At $t > 0$, however, the boat, that is the *topos* of experience, moves faster than the flow of phenomena. Then time and phenomena do not meet, nothing *actually* happens, phenomenologically speaking. Events do not take place, they remain *a-topic*. This is possible in as much as we can think, or imagine events faster than they actually happen – if they do happen at all. We can imagine a unicorn, but we are not very likely to actually meet one, and travelling to the moon was imagined by Jules Verne long before the event actually took place.

At $t < 0$ the *topos* of experience moves slower than the flow of events, which implies that time and phenomena actually do meet, that things actually do happen, that phenomenologically speaking events do take place. Compared to Jules Verne's speculations about how to get to the moon at $t > 0$, $t < 0$ would be the NASA Laboratory. At $t < 0$ we are inside "the empirical limit", to borrow one of Eco's terms[21], or "the event horizon" in Penrose and Hawking's words[22].

Fig. 5 shows the Butterfly as the hyper surfaces in fig. 4 seen from above at the three t values. Fig. 4b shows the four bifurcations, or locations of the C-points, that emerge at $t < 0$. As will be demonstrated below, the Butterfly is first and foremost of interest to architecture when $t < 0$. That is how I will use it, and that is the condition of the Butterfly under which it generates the graph whose iconical quality gave name to this type of catastrophe. The graph is the projection of the cross section of the Butterfly at *origo* or at the Butterfly-point.



The Hypersurface of the Butterfly at t > 0. The two typical trajectories through it are marked a and b.

The creodes generated by the topologies of trajectory a, passing from one cuspoïd to the other inside the hypersurface.

The creodes generated by the topologies of trajectory b, passing through from one side os the "wave" to the other.

Figure 6.
The Passage at t > 0.

Between Conception and Memory

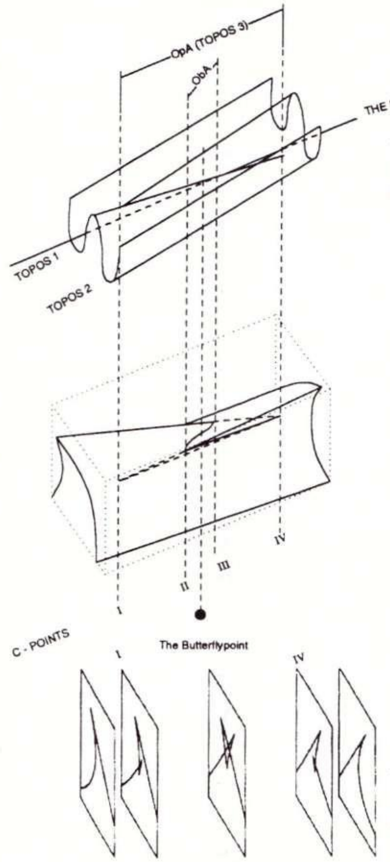
The OpA interface can be described in semiotic terms, in ontological terms, or in terms of the pattern of activity that link the first two descriptions.

The semiotic description would unfold within a scenario basically consisting of client, architect and user, and concern the process of conceptualization. I am referring to architect, client and user not as persons, but as roles or principles, as actants.

The ontological description would unfold within a scenario basically consisting of fact, or the world as given to us, of misfit or problem, let us say in the form of rain and snow, and of competence – to satisfy the need for shelter; to regulate the misfit. This description would concern the process of attaining knowledge.

The horizon of the semiotic perspective is hence conception, and memory is the horizon of the ontological perspective. These are both central perspectives in a design theory.[23] In the following I will, however, focus on the Butterfly as a way to describe topologically the pattern of activity which is at play between conception and memory.

At $t > 0$ there are no singularities regulating the two positions, conception and memory, or the relationship between them. The topology of the relationship is shown in fig. 6. Here we see that there



The creodes generated by the characteristic topologies "Petitot-trajectory" through the Butterfly at t < 0.

The Hypersurface of the Butterfly at t < 0.

Typical sections showing first the cuspoïds forming the polarities of the hypersurface, then the Swallow tails corresponding to C-points I and IV, and the section at the Butterflypoint in the middle.

Figure 7.
The Passage at t < 0.

is no passage between position, or TOPOS 1 and TOPOS 2. The relationship between them would hence be subject to the same kind of weakness, or arbitrariness as the one that has always been menacing linguistics and linguistically based semiotics.

At $t < 0$, however, when time and phenomena do meet, such as in the NASA Laboratory, the succession of events occur as bifurcations in the hyper surface – which is now folding. Given FoA as general context, this folding corresponds to the events at play when a piece of FoA's space-time is actualized. See fig. 7.[24] For the sake of convenience let us start from conception.

The entire Butterfly is now inscribed in FoA. Before and after our model in fig. 7 there is in other words architecture in general; the general condition of FoA without consideration of misfit. Let us say that it corresponds to a condition of $t \geq 0$. We can now imagine that at the point where our butterfly-model starts is where the misfit enters and starts to exercise a pressure upon FoA. We can imagine that this pressure retards the movement of our boat causing the t value to drop below zero. Let us say that this is where conceptualization starts; when the notion occurs that the architectural environment fails to perform as it is intended to do. This notion of course frequently occurs only to vanish again without leaving any trace in FoA. As our topic is design theory, I will however presuppose that the notion persists in troubling us, inducing the reflection that leads to the formulation of a problem and therefore to the first step towards solving it. This would be the phase of conception. In terms of the semiotic scenario this phase would imply that man, in the sense of the ultimate user of architecture, bifurcates into user and client. The architect has a special status. He is in a certain sense external to the scenario. We shall return to that.

At the other end of our model we would have the phase of memory. In terms of the ontological scenario this phase would imply the bifurcation of the world in general into the three entities: fact, problem and competence.

Now; we can imagine the condition of $t < 0$ exercising an external pressure upon the model which causes the two phases to fold into each other and form an interface between conception and memory. This interface is thus formed by the system of bifurcations hence created.

Inscribed in a spatio-temporal phenomenology, which is what I am trying to do here, each bifurcation represents a singularity, an event, a spatio-temporal phenomenon. In these terms the butterfly is, at $t < 0$, a gestalt which is composed of a number of spatio-temporal phenomena.[25]

Let us have a look at one bifurcation at a time. According to a spatio-temporal order of succession the first bifurcations would be caused by the breaking of the top curve of the butterfly. This occurs when the opposition between "man" on one side, and the world-as-given on the other causes the t value to fall below zero.

The first thing to happen in the semiotic scenario is that man experiences resistance from the world. This experience induces two bifurcations, one in man and one in the world. Man bifurcates because "man" can not experience anything. Experience is individual, it presupposes a particular *topos*, somewhere to take place. Man-in-general thus emanates one particular, experiencing man.

The corresponding bifurcation in the ontological scenario is that the world-as-given bifurcates. The world-as-given is a general concept, but the world can not be experienced in general. Only particular parts, or points, or aspects of it are accessible to experience. The world hence emanates a particularity which is experienced by the experiencing man as a point of resistance, like for instance a pouring rain falling on the stony ground.

These two bifurcations correspond to bifurcations II and III respectively, in fig. 4b.

Man and world are now embodied in a human being finding himself in one particular place where he is exposed to a pouring rain. This situation generates another set of bifurcations.

In the semiotic scenario we have already seen man-in-general become one particular, experiencing man. Now experiencing-man bifurcates and becomes one perceiving experiencing-man and one acting experiencing-man. The first is a collective condition in as much as all members of a community experience. The second is an individual condition in as much as when a community acts, it does so through a representant acting on behalf of the collective. The first is the user, and the second is the one who takes on, or is given the task of doing something about the rain. This is the role which in an architectural context is referred to as the client.

In the ontological scenario the point of experience bifurcates in a problem, which is that of getting wet and cold, and potential solution, which is that of building a shelter from the stones on the ground. The rain can be called a threatening fact, and the stone a helping fact.[26]

The OpA interface is hence composed of–, and regulated by these four singularities (threatening fact, helping fact, client and user). According to a spatio-temporal order of succession they appear in couples, first the problem and the user, I and IV in fig. 4b, then the helping fact and the client, II and III in fig. 4b.

According to a historical order of succession, which would be the order in which the OpA interface is actualized as architecture, the singularities, or in this context rather the events, would appear successively from I to IV. Two more elements are however required in order for the actualization to be realized. Now we are coming to the architect, and to ObA.

In narratological terms the architect would be the hero which is appointed to act on behalf of the community. The community is in our scenario composed of client and user. The client is appointed to represent and to act on behalf of the user(s), like the mayor of a village. Because the client has a general representative role to maintain, he is bound to respect the social contract and his position within the community. In order to go on a special mission, like killing a drake or "neutralize" a mad scientist behind enemy lines, one needs a special agent who can move and act unrestricted by social regulations; one who is "licensed to kill". St. George was such an agent, and James Bond another one. The equivalent to social regulations in our context are the positions who compose the pluri-actantial gestalt[27]. In our context the architect is therefore the special agent who is licensed, not to kill, but to move freely between the positions, and ObA would correspond to the heart of the drake or the dossiers of the mad scientist. The architect hence serves as the agent who, in terms of the OpA interface, bring the singularities of the two scenarios together, mediates between them, and actualizes or makes the mediation manifest. ObA is the actual object which represents and makes the OpA interface manifest, and by whose presence the misfit is regulated. OpA is the turning-point of the OpA interface, its very point of actualization.

Some Concluding Remarks

We can read the topologies showing the succession of bifurcations as local sections of that part of FoA in which we are active at the moment. E. g. FoA understood as a morphic field[28], formed as an epigenetic landscape.

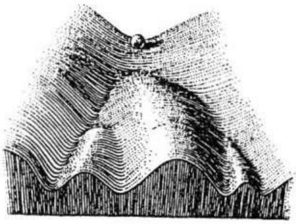


Figure 8. Part of an "epigenetic landscape", illustrating Waddington's concept of chreodes as canalized pathways of change. (From Sheldrake 1988, p. 100.)

The typical topology of the Cusp, see fig. 3, have two *minima*, positions, or attractors. The typical topology of the butterfly has three, of which, in our case, one corresponds to thought, one to thing, and one to OpA. This makes it possible, in the case of the butterfly, to follow one *minimum* emerging for instance in thought, and then wandering through and establishing ObA on its way towards and into thing. The shape of these movements is shown as '*creodes*' in fig. 6 and 7. See also fig. 8.

The correspondingly constructed system of *creodes* at $t > 0$ demonstrates a structure where the passage between thought and thing is possible only as a random leap from the one to the other across the threshold between them, or on eradicating one of the two. In its logical consequence this means that in either case there is no ternary system of minima, in both cases we would have to do with an arbitrary relationship between thought and thing.

Figure 9. Neural network in the human brain. (From Brunak & Lautrup 1989, p. 31.)

The pragmatic conjunction of architecture's material aspects and its cognitive ones by the silent and immediate act of a genius would, I believe, be epistemologically equivalent to the system of creodes at $t > 0$. In terms of the OpA interface such a design methodology, would correspond to a halt at the first bifurcation. It would leave the interface with man and world as the only singularities, without differentiating either of the two further. Neither semiotic nor ontological scenario would unfold, and we would be left with a rather simple point of existential confrontation between man and world in which only the stronger will survive.

I could think of quite a few architects who would advocate this as the only way to create "true architecture". It would undoubtfully be a true confrontation, but there are good reasons to discuss whether the result would be architecture or not, strictly speaking.

At $t < 0$ the succession of topologies, however, generate an elementary system of passages in FoA – possibly comparable to *creodes* in an epigenetic landscape, fig. 8, or *synapses* in a neural network, fig. 9. A difference between the architecture of biology or intelligence, however, and the architecture of FoA, would be the way in which we, as "products" of an epigenetic landscape, or as "inferences" of a neural network, intentionally can influence our own morphogenesis.

OpA is that condition under which the interface emerges, ObA is the material foundation of the interface and the architect is the agent who/which actualizes it. See fig. 10. This suggests a rather basic epistemological role for architecture.

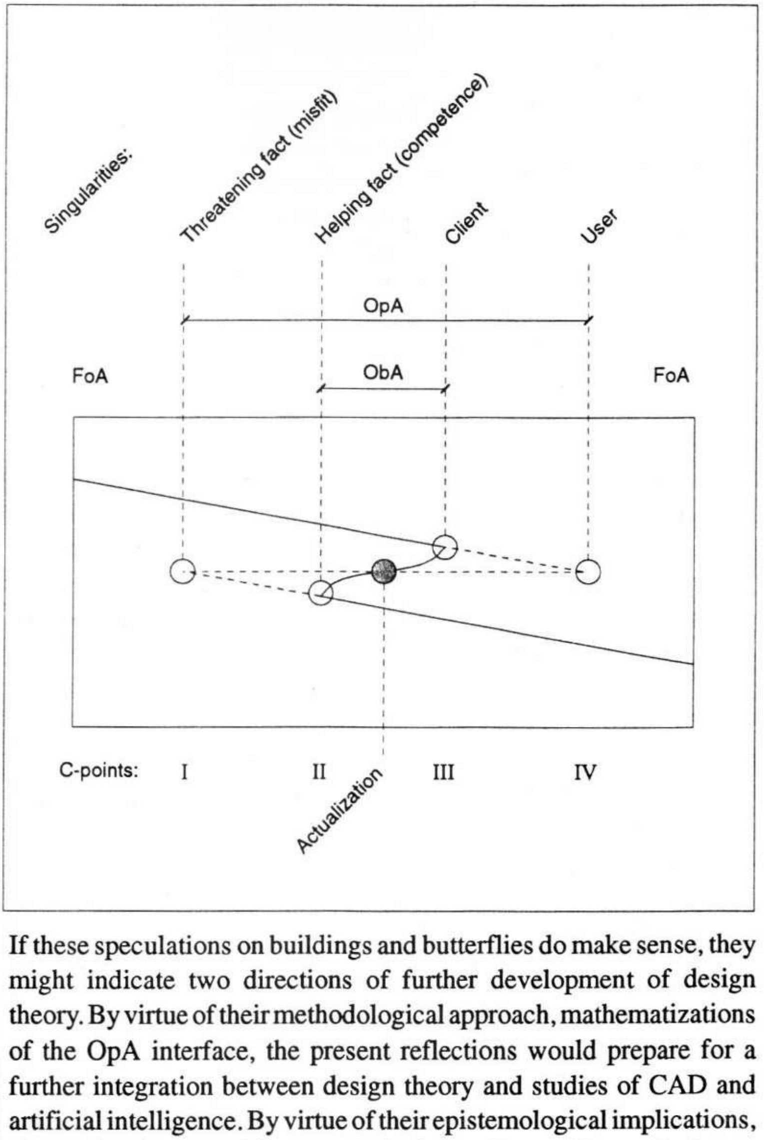


Figure 10. The OpA Interface

If these speculations on buildings and butterflies do make sense, they might indicate two directions of further development of design theory. By virtue of their methodological approach, mathematizations of the OpA interface, the present reflections would prepare for a further integration between design theory and studies of CAD and artificial intelligence. By virtue of their epistemological implications, these reflections would approach the issue of an architectonic theory of knowledge.

References

1. The reference to The Force Dynamic Theory of Leonard Talmy is deliberately kept implicit as an elaboration of this point would exceed the scope of the present text. It is, however elaborated in Møystad 1993a, p. 137 and p. 210 ff. See also Talmy 1985.
2. These two "modes of being" of architecture are referred to as architecture's first and second mode of being. Together with architecture's third mode of being they are elaborated in op. cit. Møystad, section C.1.1.3 "The Field of Architecture", p. 141ff.

3. Pérez-Gómez 1992, p. xvi.
4. Use is here meant in the broadest sense of the word, spanning from the most pragmatic and functional levels to the most reflective and aesthetical ones.
5. The initiatives of Prince Charles as well as that of the Norwegian Ministry of Culture would be among the examples of such requirements. More concretely, however, are contract formulas containing such conditions actually being used, to my knowledge, in England and France. There is little reason to believe that these are the only EG countries following such a practice.
6. A more elaborate definition of "Object" in this context, ObA, is a topic apart.
7. Cf. previous note.
8. In an interview with *NRC Handelsblad* (Holland) 11.02.93: "Het (de catastrofetheorie) is een manier van wiskundig modelleren van verschijnselen waar continue oorzaken aanleiding geven tot discontinue effecten."
9. Thom 1983, p. 59: "je dirais plutôt qu'il s'agit d'une méthodologie".
10. Thom 1989.
11. Here borrowed from Thom 1983, p. 78–79.
12. Cf. Brandt's suggestion of a stable passage between content and expression, and the 'new rational paradigm' in "Brev om by og betydning", Møystad 1992c.
13. Thom 1989, p. 60 ff.
14. Thom's latest book, which is a very comprehensible introduction to – and discussion of – CT, is alluding to this by its title: *Predire n'est pas expliquer* (To Predict is not to Explain), Thom 1991.
15. The iconicity of schemes, the relation between general scheme and particular event, is further elaborated in Møystad 1993a p. 172 ff and p. 213 ff.
16. Cf. the objections of Sussmann and Zahler discussed in Thom 1983, p. 73.ff.
17. Ibid. p. 74.
18. If my reader is interested in subjecting CT to closer scrutiny I recommend that she reads *Paraboles et Catastrophes* (Thom 1983) which is a comprehensive introduction to and discussion of CT, and *Apologie du logos* (Thom 1990) which is Thom's collected essays from 1980-1990. Recently there has been published another comprehensive introduction to the discussions around CT in the form of an interview with Thom; *Prédire n'est pas expliquér*, Paris 1992. For those who read Danish, *Morfologi og tekstvidenskab* (F. Stjernfeldt 1992) will probably be useful.
19. At this point I should mention that between each cuspoïd singularity and the Buttefly-point there does appear a third kind of singulari-

ty, the Swallow's Tail. I will however not persue this in any depth here.

20. Thom 1989, p. 68 ff.
21. Hawking 1988, p. 88
22. Eco 1971, p. 267.
23. They are both elaborated in Møystad 1993a, Part C.
24. There are of course an infinite number of possible trajectories through the butterfly. The butterfly is, however, the only catastrophe which provides the possibility of this particular one which generates the topology shown in fig. 7.

    For a further discussion of the choice of this trajectory and its epistemological implications, see Petitot 1983 and Stjernfeldt 1986. For arguments as to the particular relevance of this trajectory to architecture, see op.cit. Møystad, p. 202–208.
25. Jean Petitot refers to it as a "Pluri-Actantial Gestalt". See op. cit. Petitot, op. cit. Stjernfeldt and op. cit. Møystad.
26. Cf. the monster and the magical helper in Brandt 1991c, p. 78, and in Møystad 1993a, p. 193 ff.
27. See note 22.
28. I am using the term "morphic field" after Rupert Sheldrake, as different from "morphogenetic field" with respect to the two-way influence between field and organism in the former case. Sheldrake 1988, p. 111.

Ole Møystad, architect MNAL. Free-lance practice in Oslo. Has submitted his doctoral thesis »Architecture – the Body of Thought« to the Oslo School of Architecture, where he will be defending it in february 1994.

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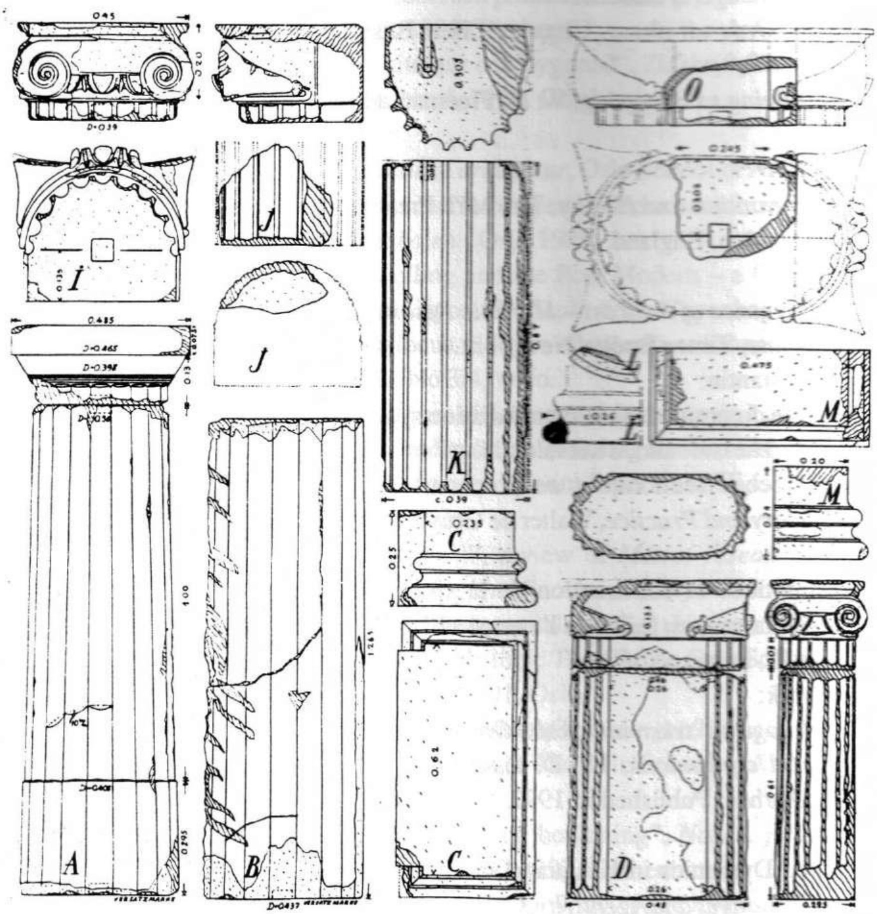

Tegningen viser nogle bygningssten fra heroon i Kalydon i Grækenland, 1:20.

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