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Ornamental Structuralism

From Rhythm to Evolution – the Future of Structuralism?

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Neo-Structuralism with a digital imprint is the label that now covers a large number of different approaches to design in architecture and urban planning, from the use of parametric data models to the implementation of genetic algorithms to evolutionary design strategies. They all have in common a rule-based design process translated into mathematical algorithms and resolved. Regardless of whether the design approaches collected under this label can even be described as *structuralist*, we are confronted with a far more interesting question: Are they potentially capable of once more taking up the failed project of 1960s and '70s Structuralism in architecture and urban development with the help of the digital medium, of developing it further, and possibly perfecting it?

The point of departure of the reflections that follow is the diagnosis, based on observation of the economic system, that the dilemma of structuralist theories lies in the fact that they lack the ability to understand the process of transformation. That is why it seems obvious that the structuralist approach can only be sustainable if it uses evolutionary design strategies – the type used in most neo-structuralist digital design approaches. After all, evolution is, so to speak, an effective and robust transformation process.

Can such an *evolutionary Structuralism* be the solution of the structuralist problem? Let us examine this question by looking at a phenomenon that can be increasingly observed in current computer-generated designs by means of evolutionary algorithms: ornamentality. A short pithy characterization of biological-evolutionary processes, artificial-evolutionary, i.e., creative processes, and artistic-evolutionary, i.e., ornamental processes will show their functional analogy. Ornamentality should thus be thought of as aesthetic, artificial evolution, and evolutionary Structuralism should be contrasted with ornamental Structuralism.

A look at the history of Structuralism shows that there has been a previous attempt to react to the dilemma of the structuralist approach with the help of ornamentality: Aldo van Eyck saw an opportunity in rhythm for overcoming the monotony of large numbers and to do justice to an *aesthetics of number*. Rhythm, however, is *the* classic program for generating ornamental forms. In view of this, one may ask to what extent rhythm as an ornamental program and evolution as a biological program are different in terms of their specific structuralization capacity.

The Dilemma of Structuralism

The question that launched the following reflections is whether the reason for the failure of Structuralism in architecture is to be found on the side of architecture or on the side of Structuralism. In view of the fact that architectural and scientific discourse has been tremendously enriched by Structuralism, we ought not to speak of failure, but rather of *restriction* or *limitation*. Therefore one might think that the limitation of architectural Structuralism is connected with the limitation of its scientific starting theory. Thus, if the limitation is due to the (scientific) theory and not to its (architectural) application, we might observe how subsequent scientific theories have reacted to the limitation of the early structuralist approach, and then draw conclusions from it for a *reload* of the architectural application.

A number of different scientific theories present themselves for such an approach. The two perhaps most prominent scientific fields of research in the period following Structuralism that have carefully examined it are, on the one hand, what is known as post-Structuralism, which tends to be philosophical in character and, on the other hand, the so-called structural sciences, which tend to be mathematical in character. Beside – or, to be more precise, between – these two positions, there is a third discipline, however – one that has so far received relatively little attention in architectural discourse. This discipline, which is also characterized by a determined confrontation with Structuralism, is system theory-oriented social science.

The reason this discipline is so interesting for the question being raised here is that by examining it it is possible not only to see the limits of Structuralism and how to overcome them, but also how a connection between this fundamentally epistemological problem and the artistic problem of ornamentality can be imagined. If, for example, one summarizes Niklas Luhmann's diagnosis regarding Structuralism, then the dilemma of structuralist theories lies in the fact that they offer a *static* model that can indicate various models and the direction of development, but the one thing they cannot describe is how the process proceeds from one state of order to another. In short: Structuralist theories lack the ability to see the process of transformation.

Thus it looks as though the limitation of Structuralism is located in the concept of structure itself and the problem of Structuralism literally appears to be structural. By means of the theory building blocks of Luhmann's system theory we can now understand how this dilemma might be remedied: through the incorporation and testing of transformation theories, such as theories of self-organization, dissipative structures, autopoiesis, and evolution. The result of the kind of theory work as that which Niklas Luhmann has rigorously done since the 1960s is that Structuralism has been eliminated without giving up the concept of structure. Rather, a temporized and more dynamic concept of structure has emerged, challenging us to approach the phenomenon of structure in new ways.

The Evolutionary Aspect of Digitally Oriented Neo-Structuralism

If, then, the dilemma of structuralist theories lies in the fact that the transformation process is missing, the idea suggests itself that another way of assuring that the structuralist approach in architecture and urban planning is sustainable is to implement transformation programs. This is particularly true of digitally based neo-structuralist design approaches that use evolutionary design strategies, for evolution is actually an effective and robust process of transformation, as it were.

The reception and adaptation of evolution theory in architecture has a long tradition. Here, the very heterogeneous approaches need to be assigned to two fundamental levels of reception: a cultural theory level where the evolution of architecture as a discipline is examined, and a design theory level that inquires into evolution in the architectural design process. Current experiments with evolutionary algorithms belong on this second level, which had its decisive *start-up* in the middle of the 20th century when it became possible to simulate processes from nature with the help of the calculation capability of the computer and to apply it to design processes. Since then the fascination of evolution theory in the design practice of architecture and urban planning has continued unabated, for the potential of evolutionary theory models is enormous: It is (perhaps) the universal explanatory model for the construction, the preservation, and the transformation of structural complexity. In order to set free this potential, however, we need a completely new view of the architectural design process: From being a *systematic, linear, and hierarchical* process it must be transformed into a *self-organizing, recursive, and heterarchical* process. This change comes at a certain price, however: It means giving up complete control, giving up safe predictability, and giving up the one single solution. But if all this is factored in, then evolutionary design strategies make good solution strategies in the case of so-called *frustrated* problems, i.e., problems where there are several competing requirements and it is not possible to meet all of them simultaneously. The result of efforts in the 1960s and '70s to develop a rational planning methodology showed that the architectural design process was just such a frustrated process. In other words, the theoretical potential and technical possibilities are certainly present in an *evolutionary Structuralism*,¹ but the question is: Is that sufficient for the continuation and success of Project Structuralism?

New Ornamentality?

Here, I will pick up on a phenomenon that can increasingly be observed in current computer-generated designs by means of evolutionary algorithms: ornamentality. The process produces an exotic ornamentality that is markedly different from

¹ In applications described as *evolutionary* one would first have to check concretely whether this theoretical potential is actually being released and transformed.

traditional ideas of what is ornamental: It is not so much decorative as structural, not so much Gestalt-oriented as process-oriented, not so much surface-based as spatiotemporal, not so much static as dynamic, not so much Euclidian as fractal, not so much planned as self-organized, not so much symmetrical as asymmetrical, and not so much repeating as transforming. On a phenomenological level one can also observe how ornamentality and structurality combine into a dynamic system.

It seems no coincidence that in October 2008 ARCH+ publishes an issue entitled "Entwurfsmuster" ["Design Patterns"] and in the subtitle constructs a series of terms ranging from *grid* to *type*, *pattern*, *script*, and *algorithm* to *ornament*. Generative design strategies, structure formation, and ornamentation are brought together in this one issue. The new ornament – says the editorial – is associated with "a shift of emphasis from form finding to structure formation, and from structure formation back to architecture."² The architecture theorist Jörg Gleiter feels that the new digital procedures mark the appearance of a New Ornament: "In fact, ornament has today returned – in an almost scandalously fresh and nonchalant form. It is visible not just in the superficial appearance of advertising, fashion, or product design, but also in ornaments of spaces and computer-generated architectural design processes"³. The consequence of the digitalization of both design processes and production processes, he says, is that the separation of design and production is eliminated. According to Gleiter "the potential for the new ornament"⁴ lies in the interactive connection between the algorithmically determined design and construction processes.

A number of practitioners are more guarded in their statements. Achim Menges, for example, writes as follows regarding his research on performative patterns in *computational design*: "It should thus be noted that there was no debate regarding ornament in the approach presented here, but that a new ornament (...) could develop from here."⁵ He goes on to say: "The new ornament that can be recognised in these structures may thus be a form of expression of the aesthetics of the performative originating from the interaction of the computer-based synthesis of material, structure and environment."⁶ The architects Barkow and Leibinger take a similar view, seeing ornament in their work more as "a byproduct."⁷

² Nikolaus Kuhnert, Anh-Linh Ngo, "Editorial: Entwurfsmuster," in ARCH+, no. 189, Entwurfsmuster: Raster, Typus, Pattern, Script, Algorithmus, Ornament (October 2008): 9.

³ Jörg Gleiter, "Editorial," in *Zona. Zeitschrift für Design* no. 4, (supplement to *Abitare*) no. 494, ed. Jörg Gleiter (2009): 4.

⁴ *Ibid.*, 16.

⁵ Achim Menges, "Interactions: Performative patterns in computational design," in: *ibid.*, III.

⁶ *Ibid.*, V.

⁷ Frank Barkow and Regine Leibinger, "Architektur muss nicht brennen ... sie kann glühen. Ein methodologisches futuristisches Manifest," in ARCH+, no. 189, Entwurfsmuster: Raster, Typus, Pattern, Script, Algorithmus, Ornament (October 2008): 85.

Is the potential of an evolutionary Structuralism manifested in this strangely structural ornamentation? Or rather does not the aesthetic phenomenon of ornamentality demonstrate how inadequately the structuralist problem has been dealt with? Could it be that a certain limitation of *evolutionary Structuralism* is manifested in this *ornamental Structuralism*? The following sections will discuss this relationship of evolutionary Structuralism to ornamental Structuralism, using the term *creativity* as a connecting link.

Artificial Evolution as Creativity

Current practical applications and testing of evolutionary algorithms in drafting and design programs have once more given rise to a new theoretical discussion of the extent to which evolutionary processes can be described as creative processes.⁸ In short: Creativity is observed as artificial evolution. The basis of this is one of the first explicit connections between creative and evolutionary processes, undertaken by Donald T. Campbell in 1960 with his essay *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes*.⁹ Since then the framework of this type of creativity research has been the neo-Darwinian theory of evolution with its three mechanisms: *variation, selection, and retention*.

If we speak of creativity as artificial evolution, then what does *artificial* mean? The biological model of evolution assumes that the three mechanisms of variation, selection, and retention depend on a number of different circumstances, i.e., occur separately. The artificial process of evolution, on the other hand, is characterized by the fact that it links the three mechanisms. As the sociologist Dirk Baecker puts it: "Thus, let us say that creativity interlinks variation, selection, and retention. It consists in not being satisfied with variation, selection, and retention being a blind process without any direction nor guarantee to it, adrift, as it were, and instead it doubles variation, selection, and retention in order to make sure that it happens."¹⁰ This interlinking, however, presents both opportunity and risk: "What it risks is getting out of step with real evolution, while its great opportunity lies in providing evolution with new artifacts, natural, artificial, or technological, which may prove

⁸ Cf. Peter J. Bentley, D. W. Corne, "An Introduction to Creative Evolutionary Systems," in *Creative Evolutionary Systems* eds. P. J. Bentley, D. W. Corne, The Morgan Kaufmann Series in Artificial Intelligence (San Francisco: Elsevier, 2002) 1-76.

⁹ Donald T. Campbell, "Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes," in *Psychological Review* no. 67 (1960): 380-400. Cf. Donald T. Campbell: "Variation and selective Retention in Socio-Cultural Evolution," in *General Systems* no. 14 (1969): 69-85.

¹⁰ Dirk Baecker: "Creativity as Artificial Evolution," in: *Rationalität der Kreativität? Multidisziplinäre Beiträge zur Analyse der Produktion, Organisation und Bildung von Kreativität* eds. Stephan A. Jansen, Eckhard Schröter, and Nico Stehr (Wiesbaden: Verlag für Sozialwissenschaften, 2009) 63.

their vale as permanent fixtures.”¹¹ Accordingly the challenge of artificial evolution lies in simultaneously playing evolution and being it.

The Mini-Evolution of the Work of Art

If artificial-evolutionary processes – of the type that are frequently used in Neo-Structuralism with a digital imprint – may be observed as creative processes, then what does the connection to ornamental processes consist in? It consists in the fact that ornamental processes may be seen as the basic form of every kind of artistic, creative process.¹² The probably most radical and fundamental formulation of this connection can be found in the monograph *Die Kunst der Gesellschaft* by the sociologist Niklas Luhmann. In his treatise the sociologist observes the artistic process of creation as a mathematical process – or, more precisely a differential theory-based calculus of forms. Referring to the calculus of logic of the mathematician George Spencer-Brown, Luhmann describes the genesis of a work of art as a recursive chain of distinction generated by linking form to form. The concept of form used here differs from the traditional concept of form – a concept of Gestalt – in that it denotes the production of a difference. The artist begins at an arbitrary point, or, as Niklas Luhmann puts it: “Any random event would do”¹³. The second operation, however, is no longer random, since the first operation has left distinction and thus restricted opportunities for connectivity operations. Every additional operation proceeds in this sense, i.e., limits additional possibilities for connectivity. Artist and viewer observe, as it were, which operation can best suitably connect in each case. This sequence of formal decisions condenses into an ordered whole. Luhmann finds the basic form of such a process in the ornament: “The basic form for generating forms from other forms is the (...) ornament. (...) Ornaments are recursions that keep going by recalling previous and anticipating further forms.”¹⁴ However, in this “ornamental staggering of distinctions”¹⁵ in the work of art, says Luhmann, it is already possible to see the fundamental principles of evolutionary processes: “Once the distinctions begin to stabilize and relate to one another recursively, what occurs is precisely what we expect from evolution: the artwork finds stability within itself; it can be recognized and observed repeatedly. The work might still suffer destruction, but any further modification becomes increasingly difficult. Some insoluble problems or imperfections might remain, which must be accepted as a matter of fact. Even in art, evolution does not

¹¹ Ibid.

¹² For the consequences resulting from this in terms of a specifically *architectural* ornamentation cf.: Michael Dürfeld, *Das Ornamentale und die architektonische Form. Systemtheoretische Irritationen* (Bielefeld: Transcript, 2008).

¹³ Niklas Luhmann, *Art as a Social System* (Stanford: Stanford University Press, 2000) 31.

¹⁴ Ibid., 120.

¹⁵ Ibid., 227.

bring about perfect conditions.”¹⁶ Keeping in mind certain restrictions, he continues, one can therefore speak of the “small-scale evolution of the individual work.”¹⁷

From Evolutionary to Ornamental Structuralism

The proximity of the evolutionary and the ornamental is thus based on a functional analogy of biological-evolutionary, mathematical-recursive, and artistic-ornamental processes – a fact that, incidentally, was already suspected 100 years ago by the French art theoretician Paul Valéry¹⁸. For their very specific areas of biology, mathematics, and art, all three processes are the generating programs responsible for the generation of complex forms and structures. However, only now is it possible, thanks to the computing capability of the computer and by means of recursive algorithms, to simulate evolutionary processes from biology and to apply them to architectural design processes.

But what is the difference between evolutionary Structuralism and ornamental Structuralism, between artificial-evolutionary and aesthetic-evolutionary, i.e., ornamental processes? At the beginning of this article, I pointed out the difference between biological-evolutionary and artificial-evolutionary processes, which consists in the fact that in artificial evolution the blind flight of biological evolution is controlled by the linking and feedback of the three mechanisms of variation, selection, and retention. The difference between artificial-evolutionary and aesthetic-evolutionary processes lies precisely in those criteria that – to put it in a sufficiently paradoxical way – *evolutionary control* is based on at any one time: The primary criterion for artificial-evolutionary processes of the kind that occur in Neo-Structuralism with a digital imprint is functionality. A design object, a building, or a city must fulfill a certain function. The question here is whether this variation is functioning, so that it makes sense to select it and integrate it in the existing structure. In the aesthetic-evolutionary, i.e., ornamental process the criteria are aesthetic. Here we ask whether this variation is consistent in relation to the previous variations, so that it makes sense to select it and integrate it in the existing structure.

From the above we can see how easily one can switch from an *artificial-evolutionary* process – which is the basis of many design processes of Neo-Structuralism with a digital imprint – to an *artistic-evolutionary* process, which is the basis of *ornamental Structuralism*: One need only change the selection criteria, and already one is no longer designing architecture as technology, but as art.

¹⁶ Ibid., 216.

¹⁷ Ibid. Note the mistranslation in the English edition: The German term *Minievolution* is translated as “small-scale revolution”!

¹⁸ Cf. Paul Valéry, *Einführung in die Methode des Leonardo da Vinci* (1895) in *Paul Valéry: Leonardo da Vinci* ed. Jürgen Schmidt-Radefeldt (Frankfurt am Main: Suhrkamp, 1998).

Rhythm and Evolution

Such switching can already be observed in the Structuralism of the 1960s, when there were attempts, using ornamental processes, to liberate the structuralist approach from its dilemma: For Aldo van Eyck, rhythm was an opportunity to overcome the monotony of the large number and to conform to an “aesthetics of number”: “Differentiation and unity through rhythm and sub-rhythm – an old story a little forgotten. As I have said before, if we are to overcome the menace of quantity faced with the terrific problem of habitat for the greatest number, we shall have to extend our aesthetic sensibility: uncover the still hidden laws of what I have called Harmony in Motion – the aesthetics of number. Quantity cannot be humanized without sensitive articulation of number.”¹⁹ But it is not only the history of rhythm that has sunk into oblivion; people have forgotten that this very rhythm represents *the* classic ornamental program for generating forms. Here it was modernity that ignored this connection, under the delusion that everything ornamental should be banished from architecture. As late as the beginning of the modern period August Schmarsow had explicitly formulated this connection when he worked out *spatial rhythm* as a central category of architecture as art.²⁰ And even Hermann Muthesius was certain that rhythm, *the first law of all expression of our self, is characteristic of every human activity and is reflected in ornament.*²¹

With regard to current digitally based Neo-Structuralism, the question is whether on the artistic level rhythm can generate a level of complexity that corresponds to what can today be generated on a technical level by using evolution strategies. Do rhythmic programs have the same capability for complex structuring as evolutionary programs?

It would be rash to answer this question in the negative by pointing out that *symmetry, regularity, and repetition* – the familiar elements of rhythm – would not be capable of generating such complex structures. And before we start looking for other artistic methods of structure formation that are perhaps better able to keep pace with the potential of evolutionary processes of structure formation in nature, we should take a look at the current discourse in the field of culture theory about the phenomenon of rhythm.²² It then becomes all too clear that symmetry,

¹⁹ Aldo van Eyck (1959), quoted from: *Team 10 Primer* ed. Alison Smithson (Cambridge, Massachusetts: MIT Press, 1968) 83.

²⁰ Cf. August Schmarsow, *Künstlerische Grundbegriffe der Kunstwissenschaft am Übergang vom Altertum zum Mittelalter* (1905), (Leipzig/Berlin: Teubner, 1998).

²¹ Cf. Hermann Muthesius, “Die Einheit der Architektur. Betrachtungen über Baukunst, Ingenieurbau und Kunstgewerbe,” lecture given 13 February 1908 at the Verein für Kunst in Berlin. Berlin (Karl Curtius) 1908.

²² Cf. *Aus dem Takt. Rhythmus in Kunst, Kultur und Natur* eds. Christa Brüstle, Nadia Ghattas, Clemens Risi, Sabine Schouten (Bielefeld: Transcript, 2005) and *Rhythmus. Spuren eines Wechselspiels in Künsten und Wissenschaften* ed. Barbara Naumann (Würzburg: Königshausen & Neumann 2005).

regularity, and repetition as the familiar elements of rhythm represent only a very limited view of what is rhythmical. If instead we were to look, for instance, at Susanne Langer's "essence of rhythm" as "the preparation of a new event by the ending of a previous one"²³, it would become clear that a rhythmic movement consequently requires no exact, precise repetition. There are therefore good reasons for adhering to the traditional concept of rhythm, which has been well established in architecture, and to expand our awareness to include other, broader views of rhythm.

Ornamentation of Evolution

This is all the more true in view of the fact that in ornamental Structuralism, too, specific limits must always be taken into account – and here I have once more arrived at the beginning of my reflections, which I opened by inquiring as to the limits of Structuralism as a theory of science. The attainable *artistic* complexity of forms and *artistic* complexity of structure is not dependent on what is *technically* feasible, but ultimately on how much variety, how much complexity, can still be included and controlled by recursive consistency. And since we are dealing with aesthetic phenomena, i.e., perceptual phenomena, it must be possible to *perceive* this recursive consistency. The crucial question is: „But can one perceive this intent? Is it possible to see, to hear, to experience it in an imagination stimulated by literature? Or can one only *know* and *understand* that this is *intended*?“²⁴

The limit of any artistic structuring method, and thus the limit of *ornamental Structuralism*, lies in human perception. But because of this limit ornamental Structuralism also has a specific anthropological character.

Perhaps if we differentiate evolutionary and ornamental Structuralism we can answer the question whether and how evolutionary Structuralism as part of a Neo-Structuralism with a digital imprint has the potential for a *reload* of Structuralism: It will not be able to acquire the potential for a critical continuation of Project Structuralism unless at the same time it also always sees itself as an ornamental Structuralism. Or, to put it another way: What we need is an ornamentation of evolution. Whether this can best be made possible by rhythmification or by other ornamental methods would then need to be studied.

²³ Susanne K. Langer, *Feeling and Form. A theory of art, developed from philosophy in a new key* (New York: Scribner 1953) 126.

²⁴ Niklas Luhmann, *Art as a Social System* (Stanford: Stanford University Press, 2000) 308.