A Ten Point Guide to Morphogenesis

one
Morphogenesis is a term derived from developmental biology to describe the ability of organisms and natural systems to generate form from within. That is to say, the resources involved in the genesis of form are immanent to the organism or the system itself, and do not come from outside the system. De Landa gives as an example the way that the spherical form of a soap bubble emerges out of the interactions among its constituent molecules as they seek the point at which surface tension is minimized (De Landa 1999:120). However, the term has been adopted in architecture with rather a different emphasis. The Emergence and Design Group, who have established a masters program at the Architectural Association in London, have investigated morphogenesis through two issues of AD journal (Hensel, Menges and Weinstock 2004 and 2006). 'It is process,' they write, 'that produces, elaborates and maintains the form or structure of biological organisms (and nonbiological things), and that process consists of a complex series of exchanges *between the organism and its environment*' (my italics).

This definition separates the organism (or system) from the environment to which it connects. Landscape architects are less likely to accept this distinction. Of interest for them are the connectivities that enable form and behavior to emerge from process. Because in landscape architecture it is the system rather than the organism (for architecture read: the building) with which the designer works, the sense of a separate, or individuated, condition is much less strong.

two
All environmental processes work within parameters, or boundary constraints, that act as local principles for self-organization during morphogenesis. Pattern and feedback are significant features of morphogenesis. Generic patterns guide the self-generation of forms, which maintain their continuity and integrity by changing aspects of their behavior over many generations. Identifiable structures emerge from different combinations of pattern and feedback. In *A Thousand Plateaus* Deleuze and Guattari develop a theory of the genesis of two important types of structure: strata and meshworks.[1] Strata emerge from the articulation of *homogeneous* elements whereas meshworks emerge from the articulation of *heterogeneous* elements. Tree-structures characterize the former and rhizomes the latter. Animal species are biological instantiations of stratified structures and ecosystems are examples of meshworks. Deleuze and Guattari argue that all stratified structures, such as animal species, sedimentary rocks and social classes, are generated from common diagrams or blueprints. Likewise all meshworks, such as ecosystems, igneous rocks and precapitalist markets, have at their basis their own common diagram. These diagrams are referred to as 'abstract machines.' They generate the structural and organizational characteristics of these two very different types of condition.

three
In his 'The Nonlinear Development of Cities' (1999), Manuel De Landa proposes that cities are mixes of 'hierarchies of command and control' (strata) and self-organizing systems (meshworks). One of these structural elements typically predominates. Capital cities, such as Washington D.C.,which are 'state' cities of bureaucracy and governmental regulation, are hierarchically-ordered, while metropolises like New York - which are commercial networks - are self-organizing. 'A self-organizing structure [e.g. an ant colony] typically emerges without central planning, as a consequence of a de-centralized process,' whereas a command center is gathered around a state or royal seat of power. 'It is not a matter of opposition of one to the other; nature is filled with these two types of structure. What does matter is to determine which structure

[1] Deleuze and Guattari actually use the term 'self-consistent aggregates' but I will follow De Landa, who coined 'meshworks'.

predominates' (De Landa 1999: 25). Cities, as mixtures of stratified and meshwork patterns of organization, tend to represent some combination of market (self-organizing) and state bureaucracy (command hierarchy). According to De Landa the state or royal towns of Cairo, Peking, Paris and Madrid may be contrasted with the commercial towns of London, Venice and Amsterdam (De Landa 1999: 27). Commercial towns, often maritime, connected to the self-organizing seas and oceans, always exist in networks, which may lack a distinct center. State towns are centers that conquer other towns to enable their wealth to flow in. Like Peking, Canberra and Madrid, they are often land-locked and protected.

four

A river system is intimately interconnected with the webs of topography, vegetation and surface conditions that comprise its watershed. This goes for urban as well as rural environments. In the urban realm, buildings, transport networks and pedestrian precincts (for instance) are understood not as singular and fixed, but as energetic and material systems that share their environment with many other processes. Somewhere within these processes, principles and dynamics of organization and interaction are at work, guiding and regulating emergent urban patterns. The question is, how can we analyze these dynamics in such a way as to harness and deploy their generative potentials?

five

In order to work within these structuring processes, landscape architects need to analyze the micro- and macro-environmental conditions that moderate the systems of inhabitation and encounter that they find on the streets, in the car parks, along the urban streams and through the fluctuating urban-suburban edge conditions that make up the urban field. This requires the development of particular analytical tools, methods and skills so that found conditions can be deployed in design approaches that integrate and regulate rather than relocate or substitute. Analysis is of central importance to morphogenetic design process. Self-organizing tendencies and interactive affordances need to be discovered, and the relationships between these processes and spatial orders revealed. Of special significance are the relationships between people and the dynamic conditions that they create and inhabit. Close observation of behavior is necessary. What are the specific assemblages that comprise these human-nonhuman interactions? How do we find this out?

six

Sciences such as biology, physics and chemistry have employed mathematics to understand the behavior of physical nonlinear systems. Urbanists, landscape architects and architects work with physical systems <u>and</u> the behavior of people. Exciting new research is being done on the understanding of social and cultural institutions as dynamic evolutionary processes that interact with their physical environments. How do low-key social processes, for instance, cause major territorial disturbances? In landscape architecture we have to take account of the immersion of humans and nonhumans in the environments that support and maintain them, and find out how these environments are continually transformed on the basis of this immersive condition. The study of morphogenesis shows that discernible structural and organizational patterns underlie these interactions. When we understand these underlying 'blueprints' we can start to seed urban processes with catalysts for the development of new patterns and forms.

seven

One way to design morphogenetically, is to consider it as designing without an idea. Morphogenesis proceeds without an already envisaged result. Deleuze calls this actualizing the virtual, and contrasts it with making the possible real, which merely changes the status of something that already exists, as opposed to making something entirely new. Rather than attempting to transfer a mental image into the visual realm, morphogenesis enables the development of novelty through the operation of different instrumental strategies. The following procedure shows how a morphogenetic approach can occur at the level of representation.

eight

Instead of working with the established conventions of representation such as framing, scaling, orientation, projection, plan, elevation, section and so on, other representational devices are explored. These 'operational' procedures become the organizing programs that suggest the future state of selected terrain. Since the making occurs without pre-set ideas there is no need for a brief. The design becomes what it becomes. The operational procedures deployed are data sets, operators, diagrams, algorithms and graphic fields. The collecting ('harvesting') of data is an imaginative engagement with the 'situation.' Data sets are identified. These are usually expressed as diagrams, graphs, charts, found images, texts and site materials. It is important to understand the data as qualities rather than as objects. The emphasis is placed on activities, occurrences and events rather than on things.

Like operators, diagrams are agents of change. They can be drawn from anywhere. A diagram is a packet of information about things in various relationships with each other. These are relations of nearness and distance, motion, arrival and departure, directionality, opening and closing and so on. Designers can use diagrams to transform their material and push it in new directions.

Data is distributed across a two-dimensional plane to form a graphic field. This is achieved through the use of an algorithm, or set of rules. Through this process elements are selected and isolated from their seamlessness with other things and recombined into new relationships with different elements derived from the situation. The graphic field so formed is a diagram or 'abstract machine' of the situation to come. The virtual forces operating within the organizational structure of this diagram will become actualized by the design process.

Algorithms, diagrams and operators replace the cartographic and perspectival conventions of landscape design. The graphic field is produced by conventions of the designer's own making. The rules are derived from the situation. They can be formulated from textual data, or invented as a response to data. Rules come in many forms, for example;

Whenever x, then y

Add x to y when z

These new rules allow designers to enlarge frames, reduce scales, shift projections and combine different systems to effect novel relationships and to reorganize the field. Operators can be applied at any time in the process. Like algorithms they are drawn from the situation or are a response to it. They can be rep eatedly applied in an iterative way. The continual re-application of operators moves the material from the known towards the unknown in a self-similar but non-identical repetition called 'controlled drift.'

These procedures help us think about design in new ways. They promise strategies for moving design out of traps and clichés, and allow us to escape the clutches of tradition and typology. Handle with care.

nine

To a certain extent the above technique follows what happens when novel conditions arise in the natural world. When a sand dune forms, for instance, or when a hurricane grows out at sea. The long, slow evolution of an animal species, the massive spontaneous eruption of a volcano or the formation of a cancer cell – all these naturally-occurring events are examples of morphogenesis, of the ability of natural systems to generate form from within. Often, a small disturbance occurs, and a system reacts to this. The reaction takes the form of a movement of energy and material into a new cellular, oceanic or subterranean situation (depending on the natural process). This movement is governed by 'rules' that are intrinsic to the material system that is undergoing change. Cell formation is the result of chemical processes in which a mutually stimulating pair of substances links up to form a structure that reproduces as a whole. Solid rock becomes lava when a particular temperature threshold is crossed. In all cases interconnection amongst diverse but overlapping elements create a precondition for transformation. In all cases matter-energy flows provide the critical stimulus for growth from the inside.

ten

The task for the landscape architect is to know when and how to harness the energetic processes that drive the natural creation of new forms. This requires identifying the geometries and materials that produce form, and understanding the diagrams that drive morphogenesis. The more we know about the underlying diagram for erosion, the more we can regulate erosion processes without the necessity for concrete engineering solutions. In the example of the algae-forming water terraces proposed for the banks of the River Elbe in Germany, it was crucial that the designer understood how the ferrous content of the aquifer could be harnessed for CO2 absorption. If the landscape architect is attentive to what is already inherent in the situation being dealt with, then new forms can be developed that challenge both our functional and our aesthetic assumptions in the ongoing making of the world, even as they provide solutions to age-old problems.

References

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