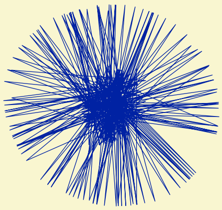
OMNES ET SINGULATIM: ART, COMPLEXITY AND EMERGENCE

PAU ALSINA
UNIVERSITAT OBERTA DE CATALUNYA
ARTNODES.ORG



The concept of emergence dates back a long way and throughout its history it has taken on different meanings in the different spheres of knowledge in which it has become relevant. If today, several theoreticians are presenting complexity as the paradigm of the new millennium, emergence seems to be becoming the explanation as to how complexity has evolved. Complexity is said to be an emerging phenomenon, and emergence is said to be what self-organised systems produce, the explanation for phenomena such as hurricanes, life itself, ecosystems and complex organisms such as humans, to name but a few examples.

The concept of emergence has certainly become an inspiring one, sparking numerous controversies, with reductionist positions such as Bertrand Russell's, for whom emerging qualities are mere epiphenomena with no scientific significance whatsoever (since «analysis [...] enables us to arrive at a structure such that the properties of the complex can be inferred from those of the parts»[1]), coexisting alongside stances such as those mentioned by physicist Doyne Farmer, who said that emergence is «not magic, but it feels like magic»[2].

Although there are many definitions of what one might recognise as emergence, one of the most widely accepted is that offered by Jeffrey Goldstein in the inaugural number of the magazine *Emergence*. For Goldstein «emergence occurs as a result of the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems. The common characteristics are:

1/ radical novelty (features not previously observed in systems); 2/ coherence or correlation (meaning integrated wholes that maintain themselves over some period of time); 3/ a global or macro 'level' (i.e. there is some property of 'wholeness'); 4/ it is the product of a dynamical process (it evolves); and 5/ it is 'ostensive' (it can be perceived)»[3].

But although this definition may meet with broad acceptance in the scientific community, it does not cover all the different nuances and definitions associated with the term; as Goldstein himself says, «emergence functions not so much as an explanation, but rather as a descriptive term pointing to the patterns, structure or properties that are exhibited on the macro-scale»[4]. Despite the lack of universal consensus on a definition, we can explain, recognise and measure emergence by its behaviour. We can recognise an emerging behaviour when it is a complex behaviour resulting from using a «down-up» construction, produced from a series of simple behaviours (e.g. simple rules). We can therefore say that emerging properties are properties of the overall system that arise out of the non-simple interaction of its parts, i.e. that refer to the properties or processes of a system that cannot be reduced to the properties or processes of its constituent parts, on many occasions leading to entirely unsuspected outcomes, which would be hard to deduce from a knowledge of the component parts and their local interactions.

For that reason we would say that the concept of emergence is not so much the product of a single organised and rigorous theory as «a collection of ideas that have in common the notion that within dynamic patterns there may be underlying simplicity that can, in part, be discovered through the use of large quantities of computer power and through analytical, logical and conceptual developments»[5]. The diversity of theories on emergence and its possible applications is vast and thus difficult to synthesise, but one might point to some of the common features shared by the different standpoints. In turn, these emerging properties are also being explored in the area of artistic praxis linked to techno-science, where this exploration aspires in some way to materialise the utopian ideal of the fusion between art and life, and ties in with the problem of creation itself.

Here, complexity theory models material systems using techniques of nonlinear dynamics, by showing the topological characteristics of diversity (distribution of singularities) affecting the series of trajectories in physical space, revealing the patterns (shown by the attractors in the models), the thresholds and the necessary intensity of the triggers (events that push systems towards pattern-activating thresholds) of these systems[6]. In this way, by showing the spontaneous appearance of indicators of patterns and thresholds in the behavioural models of complex systems, complexity theory allows us to think of material systems in terms of their power for immanent self-organisation[7].

If we centre on eight key concepts defining the historical interrelation between art, science and technology, we might start by saying that, in relation to life, emergence itself can be said to have been the underlying cause of the development of emerging phenomena in biological development, since it is the synergies produced by organised systems that allow the emergence itself to be articulated later. A change in any of the parts can affect the synergies produced by the whole, for better or for worse. A mutation associated with a single brushstroke may be «the difference that makes the difference,» as Bateson put it. From a synergistic perspective the functional effects caused by the *whole* have a lot to do with the explanations of the parts. But in the context of geneticised life, the part (gene) designates the whole (life) and the emerging dynamic as an explanation for life is reduced to control of the coded information in a contextless gene.

With regard to the role of the body, we can see how in current theories it becomes the basis of cognition; cognition which in turn becomes the process of life. The enactive conception of the organism poses the idea of a mind that is indissolubly united to the body, seen now as an embodied mind[8], in which perception is not activated merely as a response, but arises out of action in the surroundings, as movement. Cognitive structures emerge from recurring sensitive patterns, and the organism becomes a construction of a certain selection of virtual multiplicity of what the body can be. This enactive cognition represents a history of corporeal structural coupling which enacts a world (makes it emerge), and which operates through a network that consists of multiple levels of interconnected sensory-motor sub-networks. The mental contents therefore set out in their own organisation —or self-organisation— a perceived sensitive world which is in part an emergence, a self poietic creation that comes from the ordering into classes of those same mental contents. Thus, reality-world and mental phenomena are engaged in a continuous transforming dialogue, and this new model will make it necessary to reconsider developments in robotics through an attempt to create an embodied Artificial Intelligence, which emerges from the interaction with the surroundings and with the very materiality of the machine, thus configuring new adaptive computational apparatuses.

With regard to emergence in the context of artificial life, we see how artistic practices that use these technologies constantly evoke emergence and complexity with their unpredictable results ascending from a predesigned technological substratum. But it is precisely this technological predesign that confers a differentiated status on it as a «computational emergence», which we might nonetheless say is not true emergence, since it is restricted to its own technological computer model. In this way, artificial life escapes from the design of human computational models and ends up becoming something uncontrolled, with structures that do not allow themselves to be trapped in stable knowledge, formal relations or causality; because restriction of the technological framework in which emergence is trying to be reproduced as a constituent of life makes it impossible to create emergence while one is trying to formalise emergence itself. At this point it is worth noting the way in which the cultural dynamics of art itself are a much more feasible substratum for emergence, making it possible for it to be the art objects themselves that become open, emerging and unpredictable. Ironically, emergence in art with artificial life is not so much in the simulations themselves, but in the way in which these artistic practices change what we think and feel about the world.

With regard to the different theories on cognition that account for the different positions on Artificial Intelligence, we can see how it evolved from the first theories on data processing to connectionism and theories on emerging Artificial Intelligence. Starting from the connectionists' attempt to simulate natural brain processes, it fell into the romantic ideal of comparing mind and machine. Knowing by experience and not by taught instruction led to the idea of training artificial neural networks capable of learning and feeding back to the system, establishing the right connections and values for their elements. Subsequent developments in emerging Artificial Intelligence implicitly and explicitly associated computers with the human world, through all types of biological and social metaphors. The strong AI research programme made way for the weak AI programme, simulation made way for emulation and constructionism, which pragmatically uses systems of fuzzy logic, artificial neural networks, parallel computation and quantum computation to make a world experience emerge computationally.

As regards the calculability and programmability underlying the software and the programming languages, these are relevant insofar as they build ways of seeing, knowing and doing in the world, which in turn contain a model of that part of the world to which they belong and to which they give shape every time they are used. We see the Cartesian metaphors that have articulated their evolution by assigning categorisations, where the software comes to be seen as an abstraction of the hardware; or even the hardware itself becomes a metaphor when the algorithms can operate on any imagined material. It is a Cartesian dualism separating body and mind, and if it were abandoned, it could shed the assumption that it is the software that is immaterial and the hardware that is material, to such a point that the software would be seen as material contained in the coded and stored algorithm, in a further step towards the materialism of the emerging dynamics being dealt with.

With regard to the concept of the virtual, which we can address through the technologies of virtual reality and its artistic appropriation, we could show the way in which it is articulated apparently as an oxymoron while it seeks to programme a total simulation of reality itself. But this relationship between the virtual and the real is more of a co-presence, different from the possible, where potential is something future to the real, but contained within it, and the virtual is co-present with the real but different from it. We should therefore understand that the potentiality of a thing lies in the fact that any of its material properties is updated tomorrow, and thus the child becomes an adult, and so on. But in accordance with the virtual, there are certain properties that effectively correspond to the object, but which in principle are not material. Unity, for example, is predicated from objects, but it is not a material property, and although we might consider unity to be one of the transcendental categories of knowledge, we could also consider it immanently as a virtuality, i.e. belonging to matter itself and not placed from the outside by a transcendental understanding. In virtuality, the same emerging origin produces different forms not considered by potential: soap bubbles, crystals, embryogenesis, migratory movements, economic transactions, etc.

With regard to the digital, which is to be found in the relations between art and IT, we can analyse the different attributes that characterise it, the epistemological and ontological changes contributed by these new ways of going about data processing, which become structurally stripped of their containing context, giving the processing of images, sounds and texts new properties, and therefore new possibilities which have been progressively explored in the arts and engineering. From the enclave of information theory and subsequently cybernetics an area of knowledge is structured based on a series of presuppositions that model a particular idea of mind, and which, in some way, explore the ideal of the achievement of a computational mind. Out of this contextless information, properties flourish, such as the fact that it is converted into numerical representation, which can be modular, automated, variable, and transcodable. These properties have been shown to be basic in understanding the development of the computer technologies that have sought to tackle the emerging phenomena under study.

In the case of networks, we need to take into account their central position in the context of complexity theory and emerging phenomena. At the same time, we might look in detail at how systemic thinkers have applied network models to all systemic levels, seeing organisms as networks of cells, organs and systems of organs, just as ecosystems are seen as networks of individual organisms. This same vision of living systems as networks offers another perspective of the hierarchy of nature with its distributed structure, where life itself becomes a network of networks. Nonetheless, we might also speak of a law of development of networks basing ourselves on the Darwinian theory of networks, where the strongest nodes in the network —based on the context of their functional properties— will expand to become the largest and most central, at the expense of the other nodes[9]. And that analysis of the dynamics and typologies of networks allows us to see emerging phenomena in the networks themselves, as in the behaviour of ants as a model of spontaneous self-organisation in nature[10]. However, this is not entirely exact, since their behaviour is actually directed by purposes; despite the fact that the machinery of cybernetic control is distributed, ants' behaviour is directed by instructions, not by laws.

By examining the history of the inter-relations between art, science and technology from this materialist perspective, which redistributes the relations between matter and form, and by observing the immanent properties of self-organisation of matter itself, we can show the way in which art, mathematics and physics have become inter-related on the basis of different conceptions of space; the way in which art and telecommunications have explored the meaning of networks and remote communication; the way in which digitaility and the ideal of the computational mind structures the relationship between art and IT; thinking about the virtual in artistic practices with virtual reality technologies; the approximations between art and software based on exploring their potential for calculability, and therefore for algorithmic programming; the theories on cognition inherent in the relationship between Artificial Intelligence and artistic practices; the simulation of emergence that is to be found in technologies of artificial life and its artistic appropriation; the concept of body in the relationship between robotics and art; and, finally, the conceptions of life to be found in the current relationship between artistic statements and biological knowledge, and even more especially in the development of today's biotechnology.

Notes

1 Russell, B. (1927). *The Analysis of Matter*. London: Allen & Unwin. pp. 285-286.

2 Waldrop, M.M. (1992). *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Touchstone Simon & Schuster.

3 Goldstein, J. (1999). «Emergence As a Construct: History and Issues». *Emergence*. Vol. 11, 1999, pp. 49-72.

4 Goldstein, J. (1999). «Emergence As a Construct: History and Issues». *Emergence*. Vol. 11, 1999, p. 46.

5 Lissack M. R. (1999). «Complexity: The Science, its Vocabulary, and its Relation to Organizations». *Emergence*. Vol 11: 1999, p. 112.

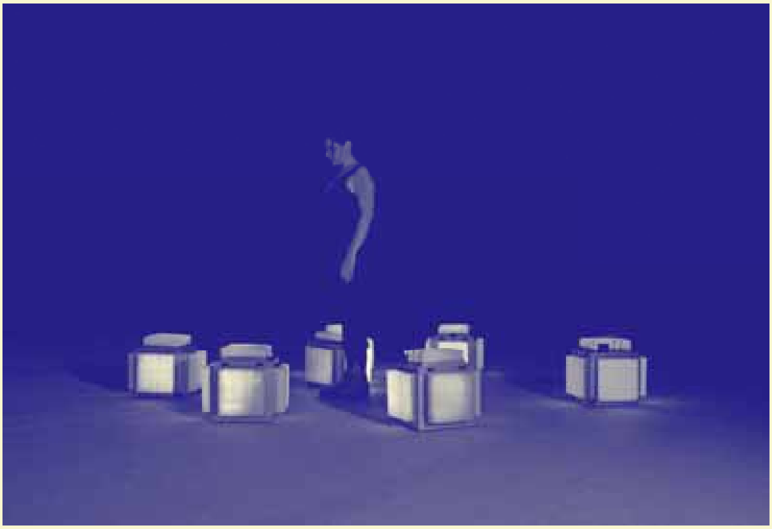
6 Protevi, J.; Bonta, M. (2004). *Deleuze and Geophilosophy: A Guide and Glossary*. Edinburgh: Edinburgh University Press.

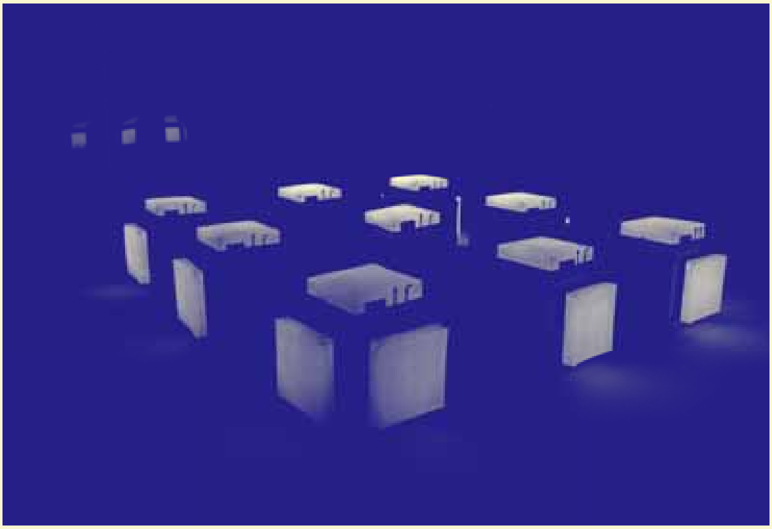
7 Protevi, J. (2006). «Deleuze, Guattari and Emergence». *Paragraph*. 29:2, pp. 19-39.

8 Varela, F.; Thompson, E.; Rosch, E. (1991). *The Embodied Mind*. Cambridge: MIT Press.

9 Barabási, A.L. (2002). *Linked: the New Science of Networks*. Cambridge: Perseus Publishing.

10 Johnson, S. (2001). *Emergence: The Connected Lives of Ants, Brains, Cities and Software*. New York: Charles Scribner's Sons.

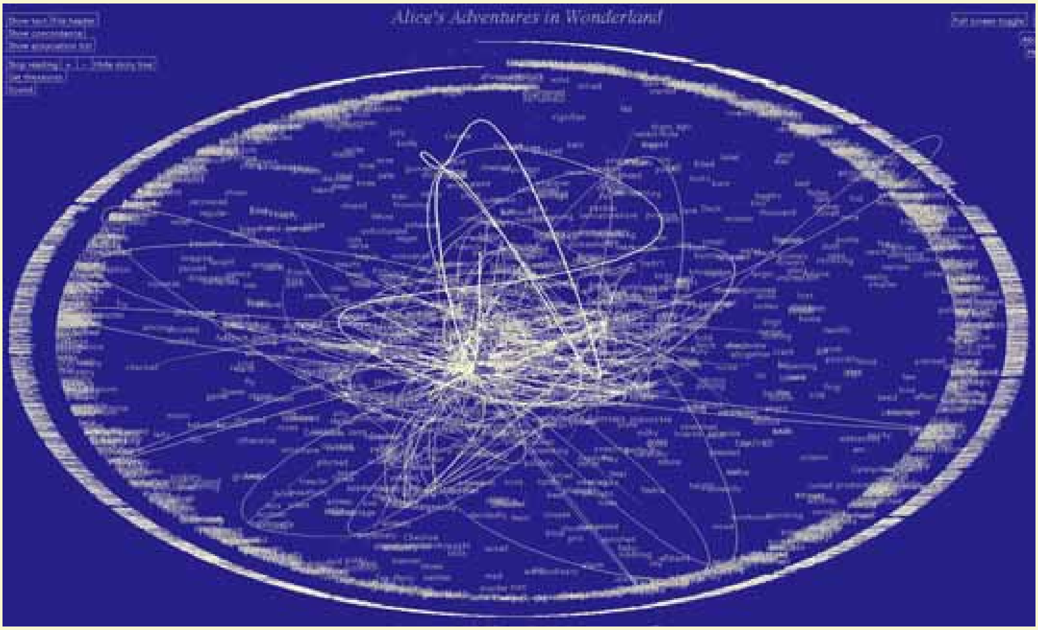




POETIC-CUBES
RAQUEL PARICIO + JUAN MANUEL MORENO ARÓSTEGUI
2007

CULT OF NEW EVE
CRTITICAL ART ENSEMBLE
2006

LIFEWRITER
CHRISTA SOMMERER + LAURENT MIGNONNEAU
2006



TEXTARC
BRADFORD PALEY
2002