

## NETWORKS, FLUIDS, CHAOS

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### The Cycle of Mobility-Mutability

Our aim in this essay is to talk about three forms of social spatiality: networks, fluids and chaos. These forms are being inscribed into various theories and are being mobilized into multiple translations (metaphors) as states in which things exist or as processes through which things are transformed. Although these spatialities are sometimes recognized in their static instantiations (as frozen topologies, static structure or equilibrium patterns), the full extent of their existence does include time-durée (as the signature of recurrent agency permeating in their modalities). Dynamic or evolving networks, non-stationary flows and irreversible chaotic processes are all examples of time dependent processes structuring these complex spatialities.

A first approach to tackle with these forms would be to conceive them as manifestations of the duality of structure and agency,<sup>1</sup> although some theorists would argue that the explanatory value of this duality is dubious and problematic.<sup>2</sup> In this context, duality means that human action and 'the social' are enabled and constrained in certain spatialities, which in turn are the result of previous actions and performances. As Annemarie Mol and John Law (1994) argue, "the social' does not exist as a single spatial type, but rather performs itself in a recursive and topologically heterogeneous manner" (p. 641). From this point of view, it is interesting to explore such spatialities - as networks, fluids and chaos - not as the material carriers or the typified niches of social action but as the situated socially topologies, which enable and frame social performances.

A particular consequence of this way to see networks, fluids and chaos might be useful in order to settle down the open accounts these notions carry over from the sciences where they have originated. From the point of view of social science and social studies, it is interesting to explore such spatialities - as networks, fluids and chaos - not as 'boundary work' exported from hard sciences (in the name of the universality of science) but as a situated geometric and dynamical context into which

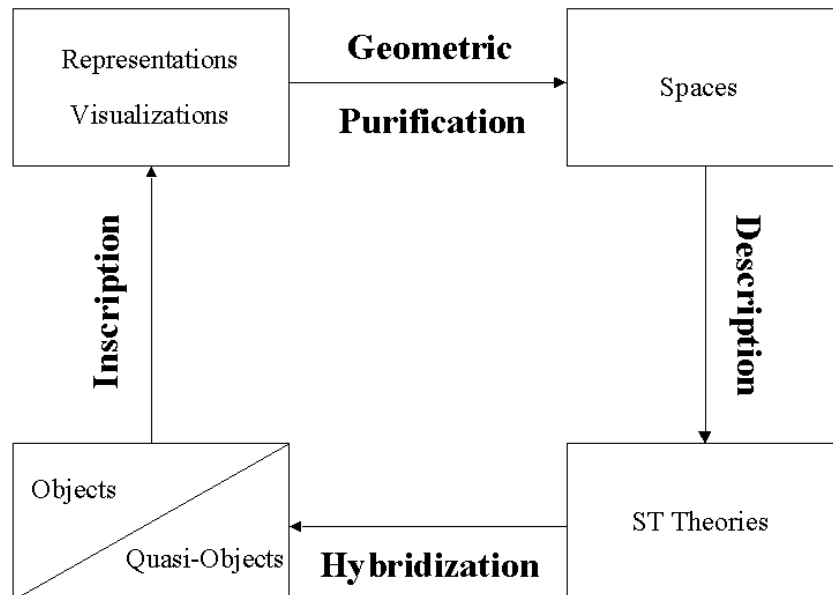
a theorization of social phenomena may develop (in the name of the localization of science ‘down to earth’).<sup>3</sup>

Understood as above, social spatialities, as networks, fluids and chaos, need to be analyzed in terms of whatever mechanisms and processes are producing their status either as scientific facts or as cultural concepts. For such a purpose, to conceptualize the construction of (technoscientific) facts in their social similarities and differences, i.e., in the social topologies where these facts are embedded, we are going to follow Bruno Latour’s (1990) approach,<sup>4</sup> which has been repeatedly applied to Science and Technology Studies. According to Latour, two are the essential characteristics of processes producing what is specific to our modern scientific culture that one has to follow if determined to avoid both ‘mentalist’ and ‘materialist’ explanations: *mobility* and *mutability*. Mobility refers to easiness in translations, displacements and movements towards various directions. Mutability is the degree to which something can change, be transformed and mutate. Combinations of mobility/mutability and their opposites produce the following table, also indicating John Law’s and Annemarie Mol’s (2000) examples of the four possible social spatialities:

<i>Mobility</i>	<p><b>Immutable Mobile</b></p> <p>networks</p>	<p><b>Mutable Mobile</b></p> <p>fluids</p>
<i>Immobility</i>	<p><b>Immutable Immobile</b></p> <p>regions</p>	<p><b>Mutable Immobile</b></p> <p>fire</p>
	<i>Immutability</i>	<i>Mutability</i>

However, the four basic spatialities (immutable immobiles, immutable mobiles, mutable mobiles and mutable immobiles) are not frozen, the one independently of the other, as if they were some fixed categorizations or ‘ideal types’ of some universal patterns of social topoi. Far from being independent variables of any sort of real or imagined universe, these four basic spatialities are linked to each other along a certain cycle that we call ‘*cycle of mobility-mutability*.’

In particular, the way we would like to see the articulation of the basic spatialities in terms of mobility and mutability is in a cycle of four successive processes: inscription, geometric purification, description and hybridization. This cycle is depicted in the following diagram:



*Inscriptions* are mobilizing distinct (immutable) objects in order to produce their representations or visualizations in the form of immutable mobiles. According to Latour (1990, pp. 44-47), generically, inscriptions are:

- o mobile,
- o immutable,
- o flat (i.e., it is possible to project them on two-dimensional visualizations),
- o scalable,
- o reproducible,
- o recombinable (through ‘optical consistency’),
- o superimposable,
- o writable to a text and
- o continuously merging with geometry (through perspective).

*Geometric purification* enhances the effectiveness of mobility by coding, encapsulating and packing the mobility characteristics into a ‘homogeneous language,’ which allows a better manipulation, presentation and combination of these characteristics. This “sophisticated grammar and syntax” is nothing else but the mathematization of space, which is produced by the techniques of linear perspective (Ivins, 1973; Edgerton, 1975) and the implied ‘optical consistency’ (Latour, 1990, pp. 27-28). Many theorists have commented the close connection between Albertian perspective and Descartes’s spatial mathematics. For instance, Martin Jay (1993, pp. 69-89) has argued that ‘Cartesian perspectivalism’ has constituted a peculiar way of seeing, in which the Cartesian subject could control space from a single vantage point.

At this point we should make a very important remark concerning the outcome of this process of mathematical or geometric purification. Although representations of physical realities lead to abstractions of Cartesian or Euclidean spaces, these spaces are not the only ones mobilized by inscriptions and not every other space, which might be produced throughout these processes, is necessarily similar in any sense to them. In fact, a variety of dissimilar (non-isomorphic or non-homeomorphic) spaces are generated by unfolding and detailing the structures over which inscriptions are registered according to the exigencies of the strategies of the followed mobilization. A zoo of linear and curvilinear, finite and infinite dimensional, metric and topological, regular and fractal, etc., spaces are proliferating in inscriptions and what they are mobilizing is not restricted to abstractions or purifications of physical or geographic proximity but something extended to other properties or relations among the inscribed objects. For example, quantities which are fields (i.e., distributed over 'continuous' Euclidean spaces and depending on time) are domesticating certain 'function spaces' (like Sobolev or Hilbert spaces), which are mathematically complex spaces, irreducible to the simple Euclidean spaces of the 'optical consistency' (although, in certain circumstances but not always, they can be approximated by them).

Furthermore, we should stress that at the same time these processes of mathematization or geometrization of space are enacted through perspectivalism and other constructions of abstract spatialities, mobility is ensured by two other processes, which, however, simultaneously alter the character of the mobilized entities. These are the processes of *erasure* and *automotacity*, which, according to Jay David Bolter and Richard Grusin (1999), together with the techniques of linear perspective, are the three strategies for achieving the "desire for transparent immediacy." From Norman Bryson's (1983) painting "as an erasive medium" to Roland Barthes's (1984) "painting of writing" and the implied erasure of the borders between literature and theory, erasure is a recurrent process in Western culture. A third strategy for achieving transparency is by the automation of the techniques of linear perspective and it has been ascribed originally to the technology of the camera obscura and later to photography, film and television (Bolter & Grusin, 1999, pp. 27-28). In particular, "through the mechanics and chemistry of lens, shutter, and film," the automated character of photography was accomplishing the earlier purpose of concealment and erasure of both the process and the artist (p. 27). For Stanley Cavell (1979), "photography overcame subjectivity in a way undreamed of by painting, a way that could not satisfy painting, one which does not so much defeat the act of painting as escape it altogether: by automatism, by removing the human agent from the task of reproduction" (p. 23).

*Descriptions*, in the mobility-mutability cycle, are the counter part processes of inscriptions of objects into their visualizations and spatial representations. In the words of Madeleine Akrich and Bruno Latour (1992), "the de-scription, usually by the analyst, is the opposite movement of the in-scription by the engineer, inventor, manufacturer, or designer (or scribe, or scripter to use Barthes's neologism)" (p. 259). The way description processes act in the mobility-mutability cycle is by freezing the 'fluid spaces' produced by the geometric purification of immutable mobiles into normative 'rigid theories,' which still can be further processed and, thus, be transformed to more organized forms of technoscientific knowledge. One form of descriptions, prescriptions (or proscriptions or affordances or allowances), is quite

important. These are usually texts (such as manuals, brochures, promotional material, critical reviews of others, etc.), which explain the spatialities of a technical object. In particular, prescription is “what a device allows or forbids from the actors (humans and non-humans) that it anticipates; it is the morality of the setting both negative (what it prescribes) and positive (what it permits)” (Akrich & Latour, 1992, p. 261). In fact, according to Laurent Thévenot (1993, pp. 100-102), technology prescriptions try to ‘discipline the usage’: (1) by issuing commands of interdicted modes that should not be used; (2) by introducing constraining conditions in the design process; and (3) by imposing norms of ‘best usage.’

*Hybridization* together with purification constitute, for Bruno Latour (1993), the two predicaments upon which one can conceptualize ‘the modern’ or better what it means to be modern. Hybridization is the proliferation of what Latour calls *quasi-objects*, objects that are both social and natural, as a result of the attitude of moderns to keep separate society and nature. In fact, what defines the moderns is that they have been able to mobilize nature for the creation of culture through the construction of networks of hybrids at a scale far more extended than before. For Latour, these hybrids and their networks are as real as their constituents are and in a sense even more real because no constituent can ever appear in its pure form segregated from anything else.

Thus, in the last phase of the mobility-mutability cycle the modern enterprise of Science and Technology returns something qualitatively different (quasi-objects) than the things with which the cycle had started (objects). Paradoxically, although the moderns keep on failing to reconcile the divide between nature and culture, they end up by filling this gap with a growing number of hybrid constructions. For Latour, the surplus value of this failure of the moderns is the modern development of Sciences and Technologies because “they multiply the nonhumans enrolled in the manufacturing of collectives and because they make the community that we form with these beings a more intimate one” (p. 108).

On the other side, for the premoderns, there was no mobility-mutability cycle as such, just a one-way route from objects to theories or from nature to culture. The premoderns could inscribe natural objects into representations and visualizations, which they would purify mathematically in order to obtain regular geometric spaces over which they would build their theoretical and cultural structures. But, by conflating nature and culture, the two ends of the route of the premoderns, there was no further stake or challenge for them to strive to achieve. Because of this, the premoderns “had the disadvantage of making experimentation on a large scale impossible” (p. 140) and they remained “forever imprisoned within the narrow confines of their regional peculiarities and their local knowledge” (p. 118).

### **Some Remarks on Virtual Spatialities**

When modern information and communication technologies mediate spatialities (and their transformations), the outcome is the emergence of something that we would call ‘virtual spatialities.’<sup>5</sup> In fact, it is through processes structuring virtual spatialities - such as digital inscriptions, algorithmic purification, morphing, simulation, etc. - that the social mediation of modern technologies is experienced.

In this sense, a digital inscription might be the first stage in the mobilization process that we have been discussing above, when it occurs in virtual space. Note that in a digital inscription certain of its characteristics can be accommodated only in digital media while they would not be consistent with traditional (printed) media. For instance, visualizations as animations of dynamic networks or simulations of flows or chaotic attractors cannot be made part of a written text unless the latter is taken in its digital form (as a hypertext or better as hypermedia in order to incorporate forms of multimedia).

As for the stage of digital purification of virtual spatialities, the role of geometric processes of mathematization is now played by processes of *algorithmic interventions*. “Digital graphics erases the subject algorithmically through the mathematics of perspective and shading embodied in a program” (Bolter & Grusin, 1999, p. 28). The latter is exactly the third strategy for achieving transparency and immediacy (now in the virtual regime) that we have discussed above: the automation of the techniques of linear perspective through an algorithmic and programmable mathematization of space. Now, geometric and perspectival inscriptions are reconstituted by rule-based algorithmic grammars and syntaxes. Morphing, a prime paradigm, which has dominated in digital media in the mid-1990s, takes the place that juxtaposition and transformation held in traditional media (Morse, 1998, p. 96).

Finally, we need to remark that experiencing virtual spatialities does not necessarily mean that one has to move, to go anywhere. This is why ‘presence’ is the key issue in order to understand the specificity of a virtual space. In fact, presence can be thought of as the experience of an environment, the sense of being there. Independently of whether one is actually placed there, presence is experienced through one’s perception, which might be mediated by automatic or/and controlled mental processes (Gibson, 1979). Now, when perception is mediated by the modern information and communication technologies, one is forced to perceive simultaneously two separate environments: the real environment of one’s actual presence and the virtual environment presented through the medium. The latter perception is called ‘telepresence’ and it signifies the extent to which one feels present in a mediated environment (Steurer, 1995). Telepresence in virtual spatialities is usually attained through simulations, i.e., technologies that aim to immerse the viewer completely within a virtual universe, as in Baroque Jesuit churches, nineteenth-century panorama, movie theaters or systems of virtual reality (Manovich, 2001).

## **Networks**

The totally pervasive character of networks in today’s social realities relies upon the specific topology, which a network supports. This is the topology of an immutable mobile (Law & Mol, 2000), since a network is always mobile, it can fleet away by continuously subsuming more distant nodes (‘distant’ in terms of either geographical distance or functional heterogeneity), while it remains immutable in the sense of always keeping to sustain the same type of relationships that define it.

In fact, networks are generally considered to be the dominant organizational forms in today’s information age (Castells, 1996; Boltanski & Chiapello, 1999). “Networks constitute the new social morphology of our societies, and the diffusion of the networking logic substantially modifies the operation and outcomes in processes of

production, experience, power, and culture. ... Presence or absence in the network and the dynamics of each network *vis-à-vis* others are critical sources of domination and change in our society: a society that, therefore, we may properly call the network society, characterized by the preeminence of social morphology over social action” (Castells, 1996, p. 469).

As José López and John Scott remark (2000, p. 1), although there are many definitions and discussions about social agency and action, very few deal with social structure and social morphology.<sup>6</sup> By its meaning in everyday life, social structure refers to patterns or arrangements of whatever elements are considered to constitute society. A particular type of structure that interests sociological investigations is relational structure, i.e., social structure as a patterning of social relationships. This structure is usually described as a *social network*, composed of *actors* and *relations* occurring among them (Wellman, 1988; Wasserman & Faust, 1994; Scott, 2000). Actors are whoever and whatever performs the agencies through which relations among actors develop and hold them together. Thus, actors (or agents) can be individual people, objects or events but they can be also aggregate units such as organizations, institutions, firms, communities, groups, families, etc. The very idea of the social network approach is that relations or interactions between actors are the building blocks or the key factors that sustain and define social structure, despite actors’ ‘nature’ or any other attributes they might be endowed with. Typically, interactions between actors result from exchange of resources they hold in the specific social and cultural contexts they are living and communicating with each other, i.e., according to the existing distribution of power or authority relationships, accepted social norms, habits, dependencies, practices, expectations and preferences. In these interactions, exchanged resources can be either material or informational or even ‘virtual,’ such as goods, money, information, services, social or emotional support, trust, influence, etc.

Although social network analysis may complement other more qualitative methods (e.g., rich ethnographic description), it is often criticized of persistence towards a rigid structural modality in its effort to distil a structural essence out of empirical data. For instance, sometimes, social network analysis is imputed on its static structuralism, which is incapable to grasp the dynamic and transformative attributes of human agency (Emirbayer & Goodwin, 1994; Emirbayer & Mische, 1998). Social action is the key concept to assist a theoretical understanding of the interplay between structural relations and discursive processes, i.e., social network analyses and ethnographic studies. Because “social action is interaction that induces interpretations and thus builds continuing relations” (Mische & White, 1998, p. 695).

In any case, the underlining paradigm in networks is grounded on an imagery of atomic particles (White, 1992; Hanneman, 1998) and molecular structures, as this is manifested in techniques of molecular visualization (Freeman, 2000). Traditionally, in graph theory, ordered networks have been modeled as crystal lattices (Harary, 1969). Therefore, it is obvious that the focal paradigm for networks is the crystal (at least in what concerns static non-random networks). Incidentally, the crystal paradigm is adopted elsewhere too, as, for instance, in postmodernist theories of writing. In this setting, Laurel Richardson (2000) argues that the “central imaginary for ‘validity’ for postmodernist texts is not the triangle – a rigid, fixed, two-dimensional object. Rather the central imaginary is the crystal, which combines symmetry and substance with an

infinite variety of shapes, substances, transmutations, multidimensionalities, and angles of approach. ... In postmodernist mixed-genre texts, we have moved from plane geometry to light theory, where light can be *both waves and particles*" (p. 934).

However, the history of physics of crystals gives us some very important lesson. As Françoise Balibar states it pretty clearly, a crystal "is an object which is now laying down the law of imperfections, whereas before, when it was still an outsider, it embodied the perfection of a natural order" (1993, p. 99). In fact, the study of crystals seemed to have stopped a long time ago, almost in the nineteenth century, a period when all the theoretical issues concerning regular structures of matter were thoroughly scrutinized and almost all relevant problems were answered. Thus, for a long period the theory of crystals was in hypnosis until the awakening of the last three decades of the twentieth century occurred. It was then when the mathematics and the physics of 'nonlinearity' refocused the interest of research on phenomena, which were previously cast aside, such as the imperfections and irregularities of crystals. As we are going to see next, a similar lesson seems to develop among the social network theorists.

## **Fluids**

The fluid spatiality, from the point of view of what degree of mobility-mutability it preserves, is a characteristic example of a mutable mobile. Like a network, it is mobile, it can move, displace and be displaced, and expand. Unlike a network, it "shows configurational variance" (Law & Mol, 2000, p. 5) that makes it change from point to point: it is like a "failed network" (*ibid.*). Unlike both solid regions and networks, the boundaries of fluids (when not confined within solid impermeable walls) are free: "Neither boundaries nor relations mark the difference between one place and another; instead, sometimes boundaries come and go, allow leakage or disappear altogether, while relations transform themselves without fracture" (Mol & Law, 1994, p. 643).

Moreover, unlike solids, fluids cannot easily hold their shape. As Zygmunt Bauman (2000) puts it, "fluids, so to speak, neither fix space nor bind time. While solids have clear spatial dimensions but neutralize the impact ... of time, fluids do not keep to any shape for long and are constantly ready (and prone) to change it; and so for them it is the flow of time that counts, more than the space they happen to occupy: that space, after all, they fill but 'for a moment'. ... When describing solids, one may ignore time altogether; in describing fluids, to leave time out of account would be a grievous mistake" (p. 2).

In *Liquid Modernity* (2000), Zygmunt Bauman investigates the processes of liquefaction enacted by modernity from its origins up to the present. In the first stages of modernity, the desire to 'melt the solids' was motivated by the need to make a brave new world cleared from all deficient solids inherited from premodern times. The way this early modern plan of 'melting the solids' was implemented was by freeing the spirit of instrumental rationality and ascribing the determining role to the economy. But the result was that the sedimented new order was more 'solid' than the replaced orders "because – unlike them – it was immune to the challenge from non-economic action" (p. 4). The new situation was limiting the individual freedom for choice and action, Bauman argues: *'Rigidity of order is the artefact and sediment of*



*human agents' freedom.* That rigidity is the overall product of 'releasing the brakes': of deregulation, liberalization, 'flexibilization', increased fluidity, unbridling the financial, real estate and labour markets, easing the tax burden, etc." (p. 5). Therefore, in the present stage of modernity (which Bauman calls 'fluid modernity'), it is the turn of patterns of dependency and interaction to be liquefied. These are the "bonds which interlock individual choices in collective projects and actions – the patterns of communication and co-ordination between individually conducted life policies on the one hand and political actions of human collectivities on the other" (p. 6). In this way, the challenge that free individuals are confronting is how to use their new freedom in order to find the appropriate niche where they could settle through conformity. However, Bauman worries, "codes and rules to which one could conform, which one could select as stable orientation points and by which one could subsequently let oneself be guided, that are nowadays in increasingly short supply. ... [They] are no longer 'given', let alone 'self-evident'; ... The liquidizing powers have moved from the 'system' to 'society', from 'politics' to 'life-policies' – or have descended from the 'macro' to the 'micro' level of social cohabitation" (p. 7). These are the changes and challenges that the advent of 'fluid modernity' has brought to the human condition, Bauman holds.

Returning to the theme of modern fluid spatialities, let us quote John Urry, who has argued that "the emphasis of a sociology of fluids (as opposed to networks) would be upon homogeneous, uneven and unpredicted mobilities" (2000, p. 38). Furthermore, Urry has indicated the following characteristics of global fluids (pp. 38-39):

- o de-territorialized and rhizomatic (Deleuze & Guattari, 1986, 1987);
- o channeled along particular scapes<sup>7</sup> or routeways (Deleuze & Guattari, 1986; Levebvre, 1991);
- o mobilizing relations among otherwise functionless features of a scape (Deleuze & Guattari, 1987);
- o moving in particular directions with no necessary end-state or purpose (Kaplan, 1996);
- o viscous (Deleuze & Guattari, 1986; Mol & Law, 1994; Shields, 1997);
- o temporal or dynamic or time-dependent (Levebvre, 1991);
- o infiltrating-escaping through the 'wall' of the scape (Mol & Law, 1994);
- o diffusing power (Deleuze & Guattari, 1987);
- o exercising power at the intersection of various fluids (Deleuze & Guattari, 1987; Mol & Law, 1994);
- o intersecting in the 'empty meeting grounds' of the non-places of modernity, such as motels, airports, service stations, the Internet, international hotels, cable television, etc. (MacCannell, 1992; Augé, 1992; Shields, 1997).

Fluids being "failed networks" can come from the liquidation of network (or solid) structures. Harrison White (1992, pp. 102-115) argues that such a 'phase transition' can be produced by two interacting kinds of uncertainty. On the one side, there is ambiguity, designating uncertainty in purely cultural context. On the other side, there is what White calls 'ambage,' designating uncertainty in purely social-structural contexts. Ambiguity is about fuzzy meanings and interpretations while ambage "concerns the concrete world of social ties, in networks of ties and corporates among nodes" (p. 107). According to White, "a polymer gel is more like social networks. These very long molecules reptate through messy, inhomogeneous environments

which include other such chains and induce new ties” (p. 70). “We are creatures living within social goos, shards, and rubbery gels made up by and of ourselves” (p. 337).

The above metaphors designate some possible future directions towards which the theory of social networks might develop in order to obtain a commingling of ‘conversations and situations,’ to synthesize adequately social structural and cultural analyses and to reconcile the structure/agency (or social topology/dynamics) dichotomy. It is interesting that, by highlighting processes of uncertain interactions and dynamic social change, these directions appear to approach the fractal landscapes of nonlinear dynamics and complex systems by following certain precipitous non-Euclidean sticky pathways.

## Chaos

In general, chaos theory is considered to refer to the economy between order and chance, determinism and unpredictability, clarity and aporia (Boudourides, 1995). From this point of view, the lesson of chaos is that the two sides of a divide can be considered reconcilable if one can deploy an iterative process (a dynamical system), which acts on the one side but asymptotically it produces a trajectory belonging to the other side. This is exactly what a ‘chaotic attractor’ (or ‘strange attractor’) is: it is a hybrid between order and randomness, because although it is generated by a regular deterministic process, asymptotically (at very large number of stages of iterations) it is found to possess stochastic nondeterministic characteristics. In other words, chaos presents a simulation of the construction of the Latourian quasi-objects.

Furthermore, chaotic patterns are not only temporal forms but they can develop spatially too: turbulent flows is an example of chaotic spatialities. These are localized spatial patterns of irregular, unpredictable, random structures, which generically might be inscribed in fractal geometry. It is remarkable that chaotic spatialities exhibit the following three attributes:

- o the continuity of the shape of a chaotic attractor contrasts the discontinuity of the terms in the generative opposition order-randomness;
- o the transformative action of a flickering relation between order and randomness;
- o the generic ‘fractal pattern’ of the chaotic attractor.

Apparently, the above three attributes reverberate Gaston Bachelard’s (1964) three attributes of fire (funeral pyre as trope of birth and rebirth, flickering between presence and absence and ‘star pattern’ of reverie) that John Law and Annemarie Mol (2000) have used in order to characterize fire as a mutable immobile. In the same sense, a chaotic spatiality can be considered to be a mutable immobile too.

In the concluding chapter of his *Postmodern Condition* (1984), Lyotard foresees that the coming of the information age will strengthen the power of the ruling elites having access to the information resources. He thinks that this totalitarian danger can be confronted by the emergence and development within natural and mathematical sciences of such theories as fractal geometry, quantum mechanics, catastrophe theory, and Gödel’s theorem. Grouping them under the label of ‘paralogy,’ Lyotard suggests that these theories will let us “wage a war on totality; let us be witnesses to the unrepresentable; let us activate the differences and save the honor of the name” (p. 82).

What seems very interesting is to compare and contrast Lyotard's emphasis on agonistics ("catastrophic antagonism is literally the rule," p. 59) with Ilya Prigogine's consensual view about a cooperative and communicative behavior far from equilibrium. In their book *Order Out of Chaos* (1984), Ilya Prigogine and Isabelle Stengers formulate this view in discussing the molecular basis of nonlinear chemical reactions: "At equilibrium molecules behave as essentially independent entities; they ignore one another. We would like to call them 'hypnons,' 'sleepwalkers.' ... However, nonequilibrium wakes them up and introduces a coherence quite foreign to equilibrium" (p. 180-81). As Alexander Argyros (1991) sees it, "Prigogine's version of postmodern science is not the cultivation of discontinuity and paradox, but a new dialogue with the natural world that respects both its otherness and our fundamental continuity with it" (p. 235). Such an outcome being optimistic, there is a pessimistic one too: "This leads both to hope and a threat: hope, since even small fluctuations may grow and change the overall structure. As a result, individual activity is not doomed to insignificance. On the other hand, this is also a threat, since in our universe the security of stable, permanent rules seems gone forever" (Prigogine & Stengers, 1984, p. 313).

Underlying the Prigogine/Lyotard contrast, there is a tangled relation between the nonlinear science of chaos and the postmodern discourse of deconstruction. First of all, there is a striking parallelism between chaos and deconstruction in a number of ways. For example, the initial focus of Derrida's work (1976, 1978) was the deconstruction of the Saussurian sign; this was an effort to establish a nonlinear relation between signifier and signified, or between sign and referent, and to affirm the destabilizing effects of undecidability. Another common characteristic refers to the openness and infinite dissemination of texts, which, thus, become susceptible to endless iterations; as a result, the boundaries inside and between text and context are not fixed so that infinite texts and contexts may permeate other texts and contexts. According to Katherine Hayles, "both discourses invert traditional priorities: chaos is deemed more fecund than order, uncertainty is privileged above predictability, and fragmentation is seen as the reality that arbitrary definitions of closure would deny" (Hayles, 1989, p. 314). The reason that the two theories seem to be perfectly congruent is, again according to Hayles, "not because they are derived from a common source or because they influenced each other, but because their central ideas form an interconnected network, each part of which leads to every other part" (Hayles, 1990, p. 184).

Nevertheless, there are many severe differences between deconstruction and chaos (cf., Hayles 1989, 1990). One of these differences is the disagreement on how extensive chaos is: for Derrida, textual chaos is almost omnipresent, but, in chaos theories, islands of order are commonly acknowledged in oceans of randomness (or the other way). Moreover, while chaos often considers a transition from order to randomness, deconstruction sees an apocalyptic break with logocentrism. Finally, although recuperation is a standard scientific practice, as it is witnessed by Popper's falsifiability, to a deconstructionist, a 'recuperator' is beyond salvation. So, Hayles (1989) concludes: "These differences are symptomatic of the different values the two camps place on chaos. For deconstructionists, chaos repudiates order; for scientists, chaos makes order possible" (1990, p. 184).

## Notes

1. This is considered as one of the most important developments in modern sociological theory as well as in philosophy. According to George Ritzer (1996, pp. 390-425), the 'structure-agency' relationship has been mostly investigated among European theorists, while, on the other side, the parallel issue of the 'micro-macro' linkage has attracted the main interest in American sociological theory. Examples of European theories: Giddens's (1979, 1984) structuration theory; Bhaskar's (1975, 1979, 1989) critical realist philosophy of science; Archer's (1995) morphogenetic approach and her concern (1988) on the linkage between culture and agency; Bourdieu's (1977, 1984) theories of habitus and field; and Habermas's (1984, 1987) integration of life-world and system.
2. As, for instance, John Urry argues: "These debates do not deal with the complex consequences of diverse mobilities; the intersecting sensuous relations of humans with diverse objects; the timed and spaced quality of relations stretching across societal borders; and the complex and unpredictable intersections of many 'regions, networks and flows'. To describe these as either 'structure' or as 'agency' does injustice to the temporal and spatial complexity of such relations" (2000, pp. 15-16).
3. Of course, this does not mean that social studies are softening 'harder facts' they borrow from hard sciences, as the notorious science warriors are prone to denounce every time they see a misappropriation of a scientific concept in the hands of their enemies (one does not need to be that much relativist in order to understand that meaning is sensitive on context). As Latour & Woolgar have pointed out, "the difference between soft and hard techniques does not depend on any absolute evaluation of the quality of techniques" (1986, p. 142). Hardness of a fact or a technique in either natural or social science depends on whatever happens later on, when this fact or technique migrates outside its original context and it is obliged to stand criticisms, modifications or refutations. Social studies are neither superior nor inferior to natural sciences; they are just different.
4. Bruno Latour's approach is inspired by agonistics, which draws its origin from linguistic games according to Jean-François Lyotard: "To speak is to fight in the sense of playing, and speech acts fall within the domain of general agonistics" (1984, p. 10). And elsewhere: "what is needed if we are to understand social relations in this manner, on whatever scale we choose, is not only a theory of communication, but a theory of games which accepts agonistics as a founding principle" (p. 60). The agonistic approach is often met in Science and Technology Studies: "If facts are constructed through operations designated to effect the dropping of modalities which qualify a given statement, and, more importantly, if reality is the consequence rather than the cause of this construction, this means that a scientist's activity is directed, not toward 'reality,' but toward these operations on statements. The sum total of these operations is the agonistic field" (Latour & Woolgar, 1986, p. 237).
5. Concerning 'virtuality,' it is worthwhile to mention Slavoj Žižek's double trap lurking our conceptualization of this situation. For Žižek (1996) the risk is twofold: either to underdetermine or to overdetermine virtuality. The way he conceives the underdetermination of virtuality is by pointing to the assertion that virtualization always existed and exists as we were and are dealing with direct, 'real' reality, even prior to the advance of computing technologies. For Žižek, "Lacan had already put it in the 1950s apropos of his famous scheme of the 'virtual image/l' *image virtuelle*': the place in the big other from which I see myself in the form in which I find myself likeable ... is by definition virtual. ... When I speak, I always constitute a virtual place of enunciation from which I speak, yet which is never directly 'me'" (Žižek, 1996, p. 285). From the other side of the same coin, Žižek sees the trap of the overdetermination of virtuality, i.e., the hasty proclamation that "every reality [is] a virtual fiction: one should always bear in mind that

the 'proper' body remains the unsurpassable anchor limiting the freedom of virtualization. The notion that, in some not too distant future, human subjects will be able to weigh the anchor that attaches them to their bodies and to change into ghost-like entities from one to another virtual body is the fantasm of full virtualization, of the subject finally delivered from the 'pathological' stain of *a* – Which of these two traps is worse? Since they are co-dependent, front and back of the same coin, one can only repeat Stalin's immortal answer to the question 'Which of the two deviations is worse, the left-wing or right-wing?': 'They are both worse!'" (p. 286).

6. According to José López and John Scott (2000), social structure points to three independent and complementary aspects of the social: the institutional, the relational and the embodied. *Institutional structure* is "comprising those cultural or normative patterns that define the expectations that agents hold about each other's behavior and that organize their enduring relations with each other." While, *relational structure* is "comprising the social relations themselves, understood as patterns of ... interconnection and interdependence among agents and their actions, as well as the positions they occupy." Finally, *embodied structure* is "found in the habits and skills that are inscribed in human bodies and minds and that allow them to produce, reproduce, and transform institutional structures and relational structures" (pp. 3-5).
7. John Urry (2000, pp.35-35) distinguishes between *scapes* and *flows* in discussing globalization. "Scapes are the networks of machines, technologies, organisations, texts and actors that constitute various interconnected nodes along which the flows can be relayed" (p. 35). Examples of scapes are various transportation and telecommunication systems. "Flows consist of peoples, images, information, money and waste, that move within and especially across national borders and which individual societies are often unable or unwilling to control directly or indirectly" (p. 36). Flows generate new access inequalities and new opportunities, desires and risks.

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