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Systems: A Critical Introduction

The Second Law of Thermodynamics tells us that energy tends towards a state of rest. Water flows downhill. Deprived of life, a human body tends towards the horizontal, and after a while resolves into its constituent molecules. What is lost in this process is not energy itself – which according to the First Law can neither be created nor destroyed. What is lost is information: the information that tells cells to replicate, or humans to walk. Systems theory was born of a realisation that entropy – the tendency of information to dissipate – is a critical aspect of any system, from cells to galaxies, and embracing human communication, psychology and society. Systems theoretic work extends from exobiology[1] to cognitive science, and its applications range from traffic management to minimalist composition. Its terminology has entered everyday life: feedback loops, the double bind, signal-to-noise ratio, black box . . . And like most systems, it has evolved.

Shannon and Weaver's first theorisation[2] was a mathematical solution to an engineering problem: how to accommodate the massive increase in telephone traffic as the USA, post World War II, encouraged intense suburbanisation. During the first period of systems theory, then popularly known as cybernetics, the analysis provided by Shannon and Weaver informed not only communications engineering but communication generally: military technologies, psychology,[3] the life sciences and sociology.[4] The second phase – inaugurated by Maturana and Varela's autopoetic thesis[5] — embraces the pioneer ecology of von Foerster[6] and the social theory of Niklas Luhmann[7] and was associated with the raise of ecological thinking: the conception of life not as a collection of organisms but as complex and mutually interconnected processes. Some of these are biological, some meteorological, some geological, locked into mutually integrated and ordered systems. For Maturana and Varela, individual systems, like an individual human body, reacted to inputs from other systems – other bodies, other environments – with a constant tendency to self-organise in the interests of maintaining themselves. The third period began with Prigogine's Nobel Prize-winning work in chemistry,[8] the highly current variant known as chaos or complexity theory. This periodisation, derived from N Katherine Hayles,[9] suggests that the first period's almost obsessive concern with homeostasis – the tendency of systems to maintain themselves in a state of equilibrium –

coincides with Cold War paranoia and the desire to maintain the status quo after a half-century of warfare. Complexity coincides with the epoch of market globalisation. Nonetheless, systems theory is rather more than an ideological expression of an epoch.

For Shannon and Weaver,[10] articulate communication lies sandwiched between randomness and repetition. Too much of either, and the message becomes either noise or repetition. They provided a mathematical expression based on probability: the information content of a message could be described as a balance between zero probability (no hierarchy of likelihood to guide the receiver) and infinite probability (any message could be entirely predicted, and therefore contained nothing new, no information). Extended to the cosmic scale of the laws of thermodynamics, the universe lies in an equilibrium state between boiling away into random jostling or freezing into a crystalline lattice. Reflecting a shift from the talismanic technologies of the past – the clock for Newtonian mechanics, the steam engine for the Victorians, and indeed for Wiener – towards the computer and, increasingly, the global network of computers, systems theory has by now become synonymous with human and social potential, with ecologies and the utopian expectations of the internet. Nonetheless, like the structuralism it inspired, systems theory has a major drawback: the difficulty it has in accounting for change.

Homeostatic and autopoetic models share the problematic of identity. A system must first and foremost maintain itself, a problematic shared by much contemporary psychology with its premise that mind and brain, necessarily individual, are coextensive. More social theories of psychology, suggesting that mind might be better understood as inter- rather than intra-personal, are characteristically more systems-oriented, for example in the social systems theory of Luhmann[11] who nonetheless insists on strong boundaries dividing such neighbouring social systems as law, polity, economics and media, each of which interacts with the others without, however, losing its integrity or its internally driven systemic processes.

Complexity theory seems far more suited to descriptions of dynamic systems. Yet its enthusiastic adoption among right-wing free market ideologies suggests that its apparently anarchistic propensities may ride closer to Stirner than to Kropotkin. On a more theoretical plane, the emergence of order from turbulence, while offering powerful accounts of certain physical processes, does not give a clear understanding of how, when and where boundary states between chaos and system are formulated or crossed, for example in complexity's accounts of evolution. Murray Bookchin[12] is not alone in questioning the prominence given to random mutation as the key or sole motor of evolution. Nor is it entirely clear from human history that less-organised societies always progress towards more organised forms (presuming here that tyranny is less organised than democracy). The most highly developed and complex participant democracies from free Barcelona of 1937 to the *marae* (Māori meeting places) of Aotearoa have been meticulously destroyed or, in more systemically enlightened times, so heavily circumscribed as to be debarred from power. Meanwhile, market capitalism is scarcely embarrassed by its overwhelming tendency towards monopoly. Near-universal trade agreements, technological standards, scientific and engineering principles testify to a de-differentiating trend at least equal to the differentiating qualities of globalisation. To the extent that information is, in Bateson's phrase, 'a difference that makes a difference',[13] these

homogenising tendencies reduce the amount of information and therefore the level of complexity in global systems. Posed as a systems theory of change, complexity theory thus requires a source of new information to counterbalance and ultimately overwhelm the entropic tendencies of globalisation. This it finds in what it perceives as the random jostling of millions of economic acts of exchange. This random aggregation of events produces information to the extent that minor fluctuations can bring about massive consequences, on the model of the butterfly and the typhoon.

There are two problems with this account. Firstly, such fluctuations, which escape measurement or prediction, are therefore by definition unknowable. It follows that no purposive action, which definitionally is known, has the power of the unknown, the random and the irrational. Such a belief has clear consequences for political life, and therefore also for any definition of order. The second problem concerns this definition. Turbulence is distinguishable from order by the excess of unpredictable and chaotic activity it names. Complexity theory posits such chaotic states as the hinterland between lower and higher levels of order. Such ordered states share with homeostatic systems the qualities of self-generation and self-maintenance. This kind of order might then, for example, be expected to arise in the contemporary movement from national to regional and global governance, in the form of treaties, shared intelligence, mutually transparent trading and reporting practices, standards of accounting and so on. Yet we have already seen that the construction of the global economy – and the same can be argued of the global polity – proceeds by homogenising and de-differentiating, and to that extent lowering the level of order in the system. Order is by nature more predictable than chaos, but therefore events occurring in an ordered system carry a lower quantum of information. Ironically the turbulent is unknowable even though it has more information content because the laws of probability regulating prediction have lowered validity in a noisy environment than in a homeostatic one. In short, complexity, like 'the invisible hand of the market', surrenders the human capacity to make history, not just the conditions under which it is made which, as Marx famously observed, we have never controlled.

The immense contributions of complexity theory to the physical sciences, to generative-transformational linguistics, and to the philosophy of technology notwithstanding, there is a sense in which systems theory vibrates sympathetically with the more pessimistic postmodernisms of 'the end',[14] with Bush and Howard's neo-liberalism no less than Blair and Clark's Third Way. At the same time there is a vast amount to gain from the work of systems theory, as long as it is understood in relationships with the other aspects of material existence. In my own field of media studies, for example, information (as homeostasis and change, whether entropic or emergent) exists in two modes: the codes, conventions, styles, broadly speaking the techniques which audiences extrapolate from media; and the data audiences feed back through the distribution chain to producers in the form of market research data and of box office and sales returns. In the former case, information is produced in the labour of attention paid by audiences to products; in the latter from the feedback loops in which product is delayed or deleted differentially in different markets. In distribution, markets and audiences are defined according to their likely consumption patterns, and market and financial data are returned differentially to different production centres and investors. As technique,

information speaks to the equilibrium of novelty and formula, as data to the preservation of privilege, power and wealth through the management of media and financial flows. In other words, information as technique relates to the organisation of mass and energy in media objects; while as distribution it speaks to the organisation of exchange in space and time.

This local example helps place information in relation to the physical and dimensional aspects of material reality. From the Second Law of Thermodynamics we know that information has an energy cost; and from Heisenberg's Uncertainty Principle that extracting information alters the dimensional relations of momentum and velocity. Material reality depends on information, but equally on space, time, mass and energy. Loose analogies with a single theme of contemporary science are suggestive, illuminating ways of revisioning the objects of social and human sciences, but they are neither value-free nor necessary. Deleuze and Guattari use systems theory to generate core concepts of their political philosophy in *Capitalism and Schizophrenia*,[15] an indication of the philosophical imagination that systems theory can promote. Their arguments differ strongly from those of Luhmann, insisting on the primacy of flow over his belief in the primacy of boundaries, and so developing a theory of both political and psychological change otherwise so difficult to produce from theories grounded in homeostasis. At the same time, though Deleuze and Guattari were also devotees of chaos theory, as political philosophers they are far more alert to the blockages that produce inequality, oppression and misery than the *laissez-faire* complexity theories of *Wired* magazine's Kevin Kelly[16] and Nicholas Negroponte.[17] Joseph Stiglitz[18] argues that their market model only works if all agents are perfectly informed, a systems-theoretic response to a crisis in the system to which too much systems theory is blind.

Lacking a dialectical or scientific theory of the relations between space and time, early versions of systems theory and more simplistic applications of complexity theory founder on the problem of change. Information alone is formless and immaterial: it needs dimensions and materiality. As the most recently discovered quality of the physical universe, information is both exhilarating and immature: a teenager, in fact. All the more reason to engage with it, but to do so with a sense that this fiery adolescent needs to form solid relationships before it can attain its mature potential.

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3 G Bateson, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution and Epistemology* (London: Paladin, 1973).

4 N Wiener, *Cybernetics or, Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 1948); N Wiener, *The Human Use of Human Beings: Cybernetics and Society* (London: Free Association Books, 1950).

5 HR Maturana and F Varela, *Autopoesis and Cognition: The Realization of the Living* (Dordrecht, NL: D Reidel, 1980).

6 H von Foerster, *Observing Systems*, (2nd edition), (Salinas, CA: Intersystems Publications, 1984).

7 Niklas Luhmann, *Social Systems*, trans. John Bednarz Jnr with Dirk Baeker (Palo Alto, CA: Stanford University Press, 1995).

8 I Prigogine, and I Stenghers, *Order Out of Chaos: Man's New Dialogue with Nature* (London: Flamingo, 1988).

9 NK Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (Chicago: University of Chicago Press, 1999).

10 Shannon and Weaver, *The Mathematical Theory.*

11 For example, N Luhmann, *Love as Passion:The Codification of Intimacy*, trans. Jeremy Gaines and Doris L Jones (Palo Alto, CA: Stanford University Press, 1986).

12 M Bookchin,*The Philosophy of Social Ecology* (revised), (Montreal: Black Rose Books, 1996).

13 Bateson, *Ecology of Mind*, 428.

14 See J Baudrillard, *The Perfect Crime*, trans. Chris Turner (London: Verso, 1996); F Fukuyama, *The End of History and The Last Man* (New York: Free Press, 1992); P Virilio, *Cybermonde: la politique du pire, entretien avec Phillippe Petit* (Paris: Textuel/Seuil, 1998).

15 G Deleuze and F Guattari, *L'Anti-Oedipe (Capitalisme et Schizophrénie I)* (Paris: Editions de Minuit, 1972); G Deleuze and F Guattari, *Mille plateaux (Capitalisme et Schizophrénie II)* (Paris: Editions de Minuit, 1980).

16 K Kelly, *Out of Control: The New Biology of Machines* (London: 4th Estate, 1994).

17 N Negroponte, *Being Digital* (London: Coronet, 1995).

18 J Stiglitz, *Globalization and its Discontents* (London: Penguin, 2002).

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