AN EVOLUTIONARY PARADIGM OF SOCIAL SYSTEMS

An Application of Ervin Laszlo's *General Evolutionary Systems Theory* to the Internet.

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MA Globalisation, Identity & Technology

Nottingham Trent University, 2003

Abstract

This thesis aims at presenting Ervin Laszlo's *General Evolutionary Theory* (GET), a particular systems theory model, as a credible framework in which to analyse and interpret the complex dynamic patterns of development of modern social technologies. GET has been a product of several disciplines of knowledge, including those of cybernetics, systems theory, and self-organisation. Also, GET is characterised by processes of complexity and non-equilibrium, and as such gives an analysis of society as moving from lesser to greater states of complexity and organisation.

Information communication technologies (ICTs) provide a model for an application of GET as they manifest growth and development through similar stages of complex and adaptive self-organisation. Specifically, the Internet and the World Wide Web (WWW) will be used as a model and application for GET respectively.

The thesis will conclude by stating that social technologies, as parts of an overall social evolution, display characteristic patterns that are applicable to GET. As such, an evolutionary model of complexity, such as GET, can have value as a tool for analysis of social systems.

Acknowledgements

I wish to express my gratitude for the assistance, advice, and supervision kindly received from my supervisor at Nottingham Trent University, Dr. Joost Van-Loon.

I would also like to express my thanks to Ervin Laszlo for his inspiration.

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INTRODUCTION

The General Evolutionary Systems Theory (hereafter known as GET) is a working theory from Ervin Laszlo that brings together knowledge from various fields, in both the natural and social sciences, to present a more unified understanding of evolutionary processes in nature and society. In GET the natural laws governing the evolution of the life sciences are used as a model by which to illustrate social systems. In this way an attempt is being made to offer a more holistic epistemological understanding. This new understanding is timely since it reflects an age where interconnectivity is fast becoming the central metaphor and where the research and study of knowledge is increasingly crossing all boundaries. GET is a combination of various disciplinary studies pooled together to offer a comprehensive overview to emergent and evolving social systems (see Wiener, 1961; Bertalanffy, 1968; Jantsch, 1980; Prigogine and Stengers, 1985).

What I aim to do in this thesis is to present an exegesis of Laszlo's theory and to give it an application within a contemporary social system. I will attempt to explain GET in terms of its functioning, and then to explore its use and relevance within a modern social context. The central question for this thesis is whether the GET model can be applied to the growth, development, and functioning of modern information communication technologies as elements of our own social development. I have chosen the Internet to be the model, and its internal patterns of communication and social connectivity, via the World Wide Web (WWW) as the application of GET.

It needs to be acknowledged that systems theory, as a discipline, is still a problematic area. Although criticised for being abstract, and for sharing essential weaknesses with nineteenth-century evolutionary theory (Abercrombie, Hill, and Turner, 2000), it is not my intention here to challenge such criticisms. Nor is it within the scope of this thesis to defend systems theory as a discipline. Instead, what I shall aim for is to present GET, a specific systems theory model, as a viable alternative framework in which to analyse social processes, such as the Internet.

The structure of the thesis will be such that the first chapter will place the relationship between the natural and social sciences in context. I shall then give an overview of the basic premises underlining the tenets of general system theory, cybernetics, self-organisation, non-equilibrium thermodynamics, and autopoiesis. This will provide us with an outline of the major areas of thinking that have come together to form Laszlo's unifying evolutionary theory of social systems – GET.

The middle portion of the thesis will concern itself with a two-stage structure. That is, it will firstly present a fuller exposition of Laszlo's General Evolutionary Theory, looking at its application to both natural and social systems. I will aim to show how Laszlo proposes to use knowledge from the natural sciences to help towards a deeper understanding of the development and processes of social systems. This will include an explanation of the bifurcation aspect of GET, central to the model and in which the evolution of social systems is firmly rooted. This aspect of bifurcation will be shown in relation to its social dimension and hence its application upon the formation of social systems.

The latter portion of the thesis will be devoted to the model and application of GET. It is here that the development and functioning of the Internet, and the WWW, along with the social implications, will be expanded upon. The final part of the thesis will be left for a summing up.

It is my hope that the thesis will go some way in showing that an updated systems theory approach to social evolutionary processes has merit and may be a credible model for analysis of modern global communication technologies.

CHAPTER ONE

THE RISE OF THE EVOLUTIONARY PARADIGM

The question of whether theories developed by the natural sciences are applicable for use in the social sciences is both practically and epistemologically important. Whilst the Enlightenment stimulated the human mind into its rational exploration to understand humankind's place within its earthly and cosmic environment, it also precipitated the divergence into natural and moral philosophy. What is termed the Cartesian split has endured into modern thought as a mechanistic, albeit rational, way of approaching knowledge through its parts rather than its sum. In order to establish an understanding of the emergent properties of social processes, as this thesis will attempt to expound, then it will be necessary to apply applications developed in the natural sciences to phenomenon normally associated with the social sciences. This does not imply a form of reductionism: that a social system is nothing more than a physical, chemical, or biological system. This would be to ignore the validity of the complexity of human life and agency, of the intra- and inter-activity of groupings, and the many effects of complex communication and connectivity between conscious beings. What is suggested, however, is that, as Ervin Laszlo (1986) has stated, 'such an entity can be analyzed in terms of concepts that apply to complex systems regardless of the nature of their parts or their place in the order of things.' (p. 271). Thus, it is legitimate, and timely, for concepts that hold for complex systems in the natural sciences to be modelled onto complex systems in social science. Not that this is novel either. Instances of the social sciences being attracted to the concepts of natural science has a history that goes back at least to the 19th Century.

Even before Darwin's publication of *The Origin of Species* in 1859 there was much intellectual activity involved in connecting biological thought to the social sciences. Comte, one of the founding fathers of sociology, claimed that 'the subordination of social science to biology is so evident that nobody denies it in statement' (Jones, 1980, p.1). What this shows us is that there was already a swelling foundation for modelling social theory on biological thought, as positivism sought order within implicit laws, before the arrival of Darwin's evolutionary propositions. In England especially, this academic activity developed alongside Darwin's published theories into Social Darwinism. Although this nomenclature is an umbrella term for many theorists (Spencer; Lamarck; Huxley; Galton), its most popularised tenet of 'survival of the fittest' was coined by Herbert Spencer. Spencer claimed that a system consisting of parts not 'adjusted to each other or to the demands of the environment will be destroyed by its competitors' (Spencer, 1971, p.24). This was joined alongside by Lamarckianism, also called 'use-inheritance', which stated that hereditary changes occurred through the organism adapting to changing environmental conditions in an upward move, and that such changes were hereditarily remembered. Lamarck's idea that evolution, as a steady, linear process, moved from lifeless matter through to man as a single upward line of improvement has been criticised by many as the 'Escalator Fallacy' (Midgley, 1985). Emerging concepts from the natural sciences continued to exert a wide range of social influence, not least upon political philosophy. The radical liberalism that pervaded the social and political atmosphere of, in particular, England, was exemplified by J.S. Mill's *On Liberty*, which was published the same year as Darwin's *Origin*. Seen in this light we can perhaps more readily accept the idea that 'Darwinism was used from the beginning as a defence of 'laissez faire' capitalism' (Jones, 1980, p.35). Also, this new scientific understanding was giving voice to elements in society at the time who were arguing for reason and morality to be linked (Jones, 1980). Social development then, and with it its economic model, had been verified, and thus legitimised, in the minds of its adherents by the solid scientific reasoning of its day.

The positioning of the natural and social sciences as being both separate from and yet not resistant to each other's ideas has maintained itself more or less to the present moment. This relationship was later referred to by C.P. Snow in what he saw as the gap of the 'Two Cultures', seeing 'the humanities and the sciences as conflictual stances disjoined by misunderstanding and misbelief'.' (Laszlo and Laszlo, 1997, p.16). Despite Snow's belief that the whole of Western society was being split into two polar groups, there was a move in the early twentieth-century towards a systemic understanding of processes that combined the principles of organisation within both a natural and social context.

Ludwig von Bertalanffy, largely credited as the founder of *General Systems Theory*, was considering his principles of shared systemic functioning at roughly the same time, 1925-26, that Alfred North Whitehead was creating his 'philosophy of organism', and biologist Paul A. Weiss began developing a systemic approach of 'conceptual integration' (Laszlo and Laszlo, 1997). However, it was not until later that Bertalanffy first presented his idea of a 'General System Theory' in a seminar at the University of Chicago in 1937. And it was later still that the public domain had to wait until Bertalanffy finally published on this subject after the Second World War. Bertalanffy's *General Systems Theory* was grounded in process thinking and a holistic framing of organismic biology to describe the organisation of living systems. This concept of the organisation of living systems was then presented within the framework of open systems, which were influenced by external environmental factors. Whereas process thinking and the holistic paradigm were not new concepts, the idea of describing living organisation within open systems was a contemporary reworking. By the 1960s 'systems thinking began to be recognised as a paradigmatic effort at scientific integration and theory formulation on the transdisciplinary plane.' (Laszlo and Laszlo, 1997, p.7). Bertalanffy, as a biologist himself, recognised that the biological sciences needed a new perspective; one that went beyond the traditional path of the physical sciences whilst maintaining a solid biological foundation. It has been commented that Bertalanffy set out 'to replace the mechanistic foundations of science with a holistic vision.' (Capra, 1996, p.47). A strict definition of general systems theory would be 'the transdisciplinary study of the abstract organisation of phenomena, independent of their substance, type, or spatial or temporal scale of existence' (Heylighen and Joslyn, 1992). The systems approach put forward by Bertalanffy saw scientific thinking not in terms of mechanistic Newtonian forces but of the developments of relationships, patterns, and change. This change was considered by Bertalanffy to be of the nature of evolutionary processes within the whole of the natural world. This systemic approach attempted to 'view the world in terms of irreducibly integrated systems' and to focus attention 'on the whole, as well as on the complex interrelationships among its constituent parts.' (Laszlo and Laszlo, 1997, p.10).

To overcome the dilemma of increasing entropy that, as the second law of thermodynamics states is increasing disorder as energy becomes used up within closed systems (Rifkin, 1985), Bertalanffy recognised biological metabolism as a self-regulatory system transferable to general open systems. Although Bertalanffy recognised the need for open systems to operate outside of classical thermodynamics, he was unable to account for them as being anything other than stable systems. This led to Bertalanffy publishing his *General System Theory* (1968) which posited a 'general science of wholeness' involving individual organisms and their parts, social systems and ecosystems (Capra, 1996). This was a significant shift in the approach of scientific thinking in that Bertalanffy regarded knowledge as being constructed not through the structure or parts of a system but rather within the processes, relationships, and patterns that create the overall wholeness of the system. The major aims of general system theory tend towards integration in the various sciences, natural and social; developing unifying principles running 'vertically' through the individual sciences; and a needed integration in scientific education (Bertalanffy, 1968). It can be seen as a bold attempt to integrate scientific understanding, using an evolutionary model of self-regulatory open systems as natural systems. Although general system theory grew out of organismic biology, it soon saw its applications reaching into the humanities, in such areas as social work, mental health, and the political and behavioural sciences (Laszlo and Laszlo, 1997). Other investigators who put their name to general system theory included Paul Weiss, Anatol Rapoport, and Kenneth Boulding. This unifying framework brought together divided disciplines, heavily paralleled the rise in cybernetics, and predated Prigogine's self-organisation of dissipative structures. In these terms, Bertalanffy's integrated approach to the organisation of living systems was the ideal precursor to Laszlo's GET, and reinforced the perspective of viewing social systems within the framework of the natural sciences.

The science known as 'Cybernetics' developed independently of the natural sciences and of Bertalanffy's general systems theory. Cybernetics investigated patterns of communication within closed loops and networks, leading to ideas of feedback and self-regulation, which ultimately steered cybernetics towards the notion of self-organisation. Originally cybernetics concentrated on the study of information-processing and used information as the key to its processes. Information, as a coded message, essentially operated as a pattern of organisation, which was under modification through a constant regulatory system of negative feedback. Negative feedback is that which aims to return a system to its pre-set order when fluctuations appear, as does a room thermostat. This gave rise to the concept of 'information processing' within networks of increasing organisation, which led to Claude Shannon's famous 'Information Theory' model that was concerned with the transfer of a signal, or information, through a given medium.

Such notable academics as John von Neumann, Norbert Wiener, Claude Shannon, and Ross Ashby, who became known as the cyberneticists, gathered together during the Second World War and were mathematicians, neuroscientists, social scientists, and engineers. This new perspective in science was geared towards shaping a unified approach to concepts of communication and control. Norbert Wiener, one of the core figures in the new movement, derived the world 'cybernetics' from the Greek *kybernetes*, meaning 'steersman' (Capra, 1996). Initially Wiener defined cybernetics as the science of 'control and communication in the animal and the machine' (Wiener, 1961, p.4). Whereas general systems theory approached the concept of systemic organisation from the biological sciences, the cyberneticists examined processes of communication and patterns of cognition through various channels within both mechanical and neural structures. In effect, they were seeking for a systemic understanding of cognitive functioning that could be applied to mathematical models for computer circuits that would later lead to theories of artificial intelligence. From Wiener's perspective, cybernetic feedback loops could assist in the formulation of information processing within a variety of contexts and could serve to be the central metaphor for communication. It would be this central metaphor that would later help as a constructive model for intra-cellular processes and communication within the genetics of molecular biology (Loewenstein, 1999). Wiener, especially, saw the brain as such a network of connectivity that worked under a systemic pattern of organisation and wholeness. We can see from Wiener's thinking that he was beginning to understand processes as patterns of relationships rather than as parts, as is shown in the following quotation: 'To describe an organism, we do not try to specify each molecule in it, and catalogue it bit by bit, but rather to answer certain questions about it which reveals its pattern.' (Wiener, 1989, p.95). This view would come back into favour and prominence during the nineteen-seventies when the concept of self-organisation retook the stage as the principle paradigm for system theorists.

Although the idea of self-organisation had been worked with by the cyberneticists in the late forties and early fifties, it took until the nineteen-seventies and eighties for this model to be refined to its present form by the work of various researchers working independently in several countries – Ilya Prigogine in Belgium, Humberto Maturana and Francisco Varela in Chile, and Erich Jantsch in the US. This newly refined model of self-organisation recognised that no living structure could be permanently stabilised and that 'equilibrium is the equivalent of stagnation and death.' (Jantsch, 1980, p.10). To regard equilibrium as a deathblow to living structures was a significant shift from earlier models. Jantsch, a leading proponent of self-organisation and a trained physicist, recognised that both Bertalanffy's and Wiener's earlier approaches had been developed on the basis of a biological perspective. This, however, was limited as 'the original vision of achieving an understanding of macroscopic order across the boundaries between the animate and the inanimate world remained vague and inconclusive' (Jantsch, 1980, p.24). To balance this, and to deal with the problem of entropy, Jantsch looked towards physics for the answers of providing a model of an open system that was not of stable order. This could then solve Bertalanffy's central difficulty in that open systems, for Bertalanffy, were prescribed stable states despite being subject to external influences. One of the characteristics of the new model was that it functioned as open systems far from equilibrium. This meant that a constant flow of energy and matter flowed through the system rather than as a closed system, thus moving away from an enclosed model of equilibrated regulation. Thus, the second law of thermodynamics, which states that the amount of free/available energy decreases in a closed system, leading to disorder, was no longer in operation. Whilst this thermodynamic law was seen as being a constant, the fact that open systems could maintain themselves with their own flow of energy and matter meant that a new type of stability could exist in a state far from equilibrium. This allowed novelty to be a key factor since the system was evolving in dynamic flows rather than dissolving under entropy, thus promoting processes and the relationships between parts rather than the parts themselves. New structures and behaviour were other key features.

This all contributes to a third feature, that of a non-linear functioning within self-organised systems. Since the emphasis was now upon dynamic flows rather than stability, the system could manifest a certain degree of unpredictability. As a summary of these characteristics it can be said that self-organisation is 'the spontaneous emergence of new structures and new forms of behaviour in open systems far from equilibrium, characterised by internal feedback loops and described mathematically by non-linear equations.' (Capra, 1996, p.85). Jantsch (1980) recognised how such processes ‘take over’ from random behaviour and develop themselves, through regulatory feedback, to facilitate the emergence of complex order. Order now was recognised as the product of the creativity of a system attempting to formulate its own internal organisation through feedback cycles. This pattern of ordering then can have profound implications for human and social sciences by understanding that complex, non-equilibrium states, creativity and novelty, are patterns of development within the emerging paradigm of evolution. As Jantsch (1980) profoundly remarked, ‘biological, sociobiological and sociocultural evolution now appear as linked by *homologous* principles (i.e. principles related through their common origins) and not just by analogous (formally similar) principles’ (p. 8).

One of the most influential fields of understanding to have contributed to self-organisation is the theory of ‘dissipative structures’ by the Russian chemist Ilya Prigogine. Prigogine was interested in knowing how living structures maintained themselves within states of non-equilibrium, especially since the law of entropy should designate their demise, and how stability at non-equilibrium could be achieved. By using non-linear equations as his benchmark Prigogine went beyond Bertalanffy’s model of the systemic patterns of open systems to express the idea that at far from equilibrium states, moments of increased instability could trigger structures of increased order and stability to emerge and replace the existing instability. That is, through feedback loops of amplified instabilities/fluctuations an open system, being interconnected to a constant through-flow of energy and matter, takes on a pattern of irreversible processes that emerge in creativity and form bonds of increased complexity.

Prigogine named this as ‘order out of chaos’, in what can be seen as a forerunner to chaos and complexity theory, as it required a minimum amount of complexity to instigate the process. Prigogine further remarked that in general such a theory could be interpreted as an evolutionary paradigm as it included ‘open systems that evolve to higher and higher forms of complexity.’ (Prigogine and Stengers, 1985, p.298). Whereas such amplified feedback loops were categorised as destructive to the earlier cybernetic model, this new understanding put forward by Prigogine saw such processes as self-evolving. The metaphor of development had been turned. Whereas the classical science model of nature was the clock, nineteenth-century science had the Industrial Revolution and the steam engine, Prigogine saw the new symbol for modern science as being ‘between stillness and motion, time arrested and time passing’ adding that ‘this confrontation will give our period its uniqueness’ (Prigogine and Stengers, 1985, p.23). Once non-equilibrium models of chemical structures could be understood as evolving processes, it seemed fitting to ask what the connection between self-organisation and life was.

The work of the neuroscientists Humberto Maturana and Francisco Varela was seminal in bringing the concept of cognition into self-organisation. Maturana made the hypothesis, circa nineteen sixty-nine, that the nervous system of living things was of a circular organisation basic to all living systems. Thus, living systems ‘are organized in a closed causal circular process that allows for evolutionary change in the way the circularity is maintained.’ (Maturana in Capra, 1996, p.96). Maturana went on to state that perception, as a product of a self-organising nervous system, is no longer a representation of an external reality but 'must be understood as the continual creation of new relationships within the neural network.' (Capra, 1996, p.96). Perception then is not a fixed domain but an ongoing process that is being constantly redefined and updated. Again, the focus is on the patterns of relationships rather than on a fixed arrangement. This revolutionary new understanding posited perception not as representation but as a process under continual modification, so making living systems as evolving in increasing complexity through a constant cognitive relationship with an integrated environment. Life was now seen as an evolving process of cognition, and this was termed as *autopoiesis* – 'self-making'. Within autopoiesis it is the function of each component to assist in the production of other components in the network, effectively maintaining itself through an 'awareness' of its own processes. Thus, an autopoietic system can be defined as a 'network of interrelated component-producing processes such that the components in interaction generate the same network that produced them.' (Laszlo, 1996, p.40). Through a constant cognition of its interrelatedness to its environment, a living system is able to maintain itself in a far from equilibrium state by a process of self-making; that is reproducing its own structure and so replacing its own network of processes in line with the flux of energy and matter. The connection between self-organisation and life had been answered by understanding that such a system has a cognitive relationship with its external environment, and works on this cognition to stabilise its processes despite being in a state of non-equilibrium.

The research briefly outlined above, a culmination of insights from physicists, chemists, biologists, mathematicians, and neurologists, has converged to provide a more holistic understanding of the evolutionary nature of systemic models. Without the sharing of the various knowledges of these diverse fields it would not have been possible to arrive, at this stage, at a grand evolutionary theory, such as Laszlo suggests. As has been stated previously, the social sciences are no stranger to biological models. There is perhaps not a better moment than now, due to the present understanding surrounding the natural sciences, to re-engage upon a project of using the evolutionary growth of living systems as a model on which to base our understanding of the complexities and instabilities of social systems. In Laszlo's view, 'the increasing complexity and interrelatedness of societies highlight the need for a systems science that combines the humanities and the sciences in an holistic interpretation of current realities.' (Laszlo and Laszlo, 1997, p.16). On an epistemological level, by combining the metaphors of the natural sciences with those of the social, linguistically as well as functionally, we shall be approaching the phenomenon of life as interconnected in every sense. This understanding may prove useful to us if we are able to transfer it to a socio-political context, as will be discussed later in this thesis.

CHAPTER TWO

AN EXPOSITION OF

GENERAL EVOLUTIONARY THEORY

Now that the growth of the systems sciences and its attendant bodies of knowledge have been framed in an intellectual context in the previous chapter, it is an appropriate step to proceed to an exposition of Laszlo's General Evolutionary Theory (GET). The question 'Why now?' has to some degree been answered by referring to the rapid advancements in the broad spectrum of the natural sciences. As I progress through this thesis I shall attempt to also show that GET is relevant to a contemporary social climate, thus answering the 'why now?' question in more than just an intellectual fashion. In the introduction to his outline of GET, Laszlo stated that:

> In the penultimate decade of the twentieth century science is sufficiently advanced to resolve the puzzles that stymied scientists in the last century and demonstrate, without metaphysical speculation, the consistency of evolution in all realms of experience. It is now possible to advance a general evolution theory based on unitary and mutually consistent concepts derived from the empirical sciences. (Laszlo, 1996, p.21).

The current exegesis of Laszlo's GET will take a three-step approach. Firstly, the basic concepts inherent in GET will be introduced and then expounded upon to give a working context in reference to empirical findings. Secondly, the key concept of bifurcation, which is central to Laszlo's theory, will be examined in its various forms.

Lastly, these concepts will be examined as to their suitability as a model for social systems, and an attempt will be made to place the direction of social evolution within this pattern, making specific reference to social bifurcations.

The systems sciences have developed a range of disciplines for application. They include such branches as systems engineering, systems management, and critical systems thinking. GET's origins lie more from a theoretical approach to systems thinking, often referred to as simply 'systems philosophy'. However, Laszlo's GET has built upon the philosophical perspective and takes into consideration not only sequences of events of a biological nature but also all open dynamic systems that have a flow of energy and information (Laszlo and Laszlo, 1997). Thus, GET deals with evolution in both the physical universe and the living world, with acknowledgement of similar models of process being applicable to societal evolution. Laszlo (1996) states that if we compare systems that have emerged over time we notice that they share a basic set of parameters, including size, organisational level, bonding energy, and level of complexity. A particular linkage is seen between size, organisational level, and bonding energy. Here, as we move 'from microscopic systems on a basic level of organisation to macroscopic systems on higher organisational levels, we move from systems that are strongly and rigidly bonded to those with weaker and more flexible binding energies.'(Laszlo, 1996, p.25). Smaller systems are then more often to be rigidly bonded as they form the building blocks of development. Those systems that have a higher complexity in their level of organisation have, at the same time, a weaker bonding and thus are more open to perturbations and disturbances. If we look at the two extremes this tells us that at the atomic level the organisation is basic, be it a rigidly set combination of protons, neutrons[1] within an atomic nucleus, yet the energy within that system is strongly bound, as made use of in nuclear fission. If it were not, the physical universe as we understand it would be too unstable for the further evolution of life. Human society, at the other extreme end, manifests a system of high complexity and organisation whilst the decreased level of bonding is demonstrated in numerous well-documented social upheavals. This picture gives us a hierarchical view of evolution. Laszlo outlines this as follows:

> Several particles jointly constitute atomic nuclei, and nuclei surrounded by electron shells form the atoms of the elements. Several atoms form simple chemical molecules, and more complex polymers are built from simpler molecules. Cells, in turn, are built from various kinds of macromolecules, organisms from cells, and ecologies and societies from populations and groups of individual organisms. (Laszlo, 1996, p.27).

It should also be noted that the level of organisation does not relate to the structural complexity of a given system. That is, a system manifesting a higher level of organisation is not necessarily more complex in structure than its sub-systems. As such, the structure of a cell colony is simpler than the internal structure of each cell. Likewise, a community of people, organised around a system, is generally simpler than the constituent structure of each individual. What Laszlo seems to be indirectly referring to here is the phenomenon of emergent properties.

The concept of emergence states that the overall properties of a system, or collective, are greater than the properties of its constituent parts. As an example, we can

[1] For the purpose of a clear example, the presence of quarks, leptons, hadrons, and other constituents of

say that the collective behaviour of an ant colony is beyond that of the behaviour of each individual ant if separated out, as the whole dynamic effect of the collective effort produces a greater outcome. Emergence is now becoming widely recognised within the science of complexity as a phenomenon that exists at every level of experience and underlies such phenomena as ecology, insect colonies, human neighbourhood communities, and consciousness (Johnson, 2002). The basic premise of emergence is that, similar to Bertalanffy's general systems theory, it recognises that the whole of something is more important that the composite parts. Emergent properties are often recognised as being products of a greater complexity of relationships, connectivity and organisation. After all, the wholeness in the functioning of the human body is a result of all its internal organs, its constituent parts, working together within complex relationships of co-operation in a systemic manner. According to Johnson (2002) 'complexity is based on a connectivity of relationships…new order is more abstract and seemingly chaotic, yet more highly patterned in its interrelatedness.' (p.48). Modelling this onto Laszlo's thought explains that the greater complexity of interaction between the sub-systems produces properties that are greater than if the total system were to be seen as a collection of separately functioning parts. This gives rise to investing the system with a holistic nature and frames Laszlo's theory within a holistic epistemology. It is in this holism that the whole manifests itself as a more simplified structure despite its internal complexity. Thus, there is no contradiction in Laszlo affirming that systems

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atomic molecular composition are not dealt with here.

of higher organisation not only often display a simpler structure but also functions in a way that is greater than the functioning of its combined sub-systems.

This leads Laszlo to posit that evolution is not only a system of structural hierarchy but also one of an increasing hierarchy of control: ‘less complex systems on a higher level of organisation can effectively control more complex systems on a lower level in virtue of the selective disregard on the higher controlling level of the detailed dynamics of the lower-level units.’ (Laszlo, 1996, pp.27-28). So whilst the new hierarchical level may have control over certain behaviour in its sub-systems, and also while it usually displays a higher level of organisation, it is in fact a structural simplification of the overall total system. However, according to Laszlo (1996), once a new hierarchical level has emerged, it initiates its own drive towards greater complexity. Thus, whilst a newly reached level of higher organisation ‘means a simplification of system function, and of the corresponding system structure, it also means the initiation of a process of progressive structural and functional complexification.’ (Laszlo, 1996, p.28). What Laszlo is indicating here is that when a number of smaller systems have combined to create an overall system, then this newly simplified structure once again evolves towards complexity, to initiate yet again this whole process of systemic simplification. This, for Laszlo, is how evolution propels itself: systems converging towards greater levels of organisation through a process of complexification to simplification, back to complexification again. However, as I shall explain, this is not always a linear process.

Two questions that immediately present themselves here are why it is that evolutionary processes drive themselves towards greater complexity in structure and function, and what events influence the trajectory of hierarchically evolving systems? These two issues are not only core to Laszlo's GET but are also central to understanding how this theory may apply to the social domain. The first question can be answered if we take a look at thermodynamical equilibrium and the dynamics of complex systems.

The Dynamics of Complex Systems

According to the work of Ilya Prigogine on thermodynamics and dissipative structures, for which he was awarded the Nobel Prize, systems in the known world can exist in one of three types of states: **in** thermodynamical equilibrium; **near** thermodynamical equilibrium; or **far from** thermodynamical equilibrium (Prigogine, 1977, 1985). In a state that exists in thermodynamical equilibrium, the flows of energy and matter in the system cancel out differences, thus producing a system that is dynamically inert although structured, as in a crystal. In a state near thermodynamical equilibrium there are but minor differences in concentration and temperature. The system is neither random nor inert and tends to move towards equilibrium as soon as its differences can be compensated for (Laszlo, 1991). A state near to equilibrium is said to be one of linear equilibrium since its rate of entropy, dissipation of free energy, is more or less predictable. A simple example here may be the thermostat that regulates room temperature. Due to fluctuations in external air temperature the overall room temperature may deviate slightly from that required, which in turn activates the thermostat into compensating for the difference and returning the room temperature to its required level, thus restoring equilibrium. This is a predictable process, and remains centred on restoring equilibrium. In the third state, far from equilibrium, systems manifest indeterminate behaviour and 'pass through chaotic phases in the course of which they may amplify certain fluctuations and evolve toward new and complex and dynamic energy regimes that are radically different from states at or near equilibrium.' (Laszlo, 1992, p.240). As way of an example, if we visualise the way bath water exits when we have pulled the plug we will notice that it creates a vortex around the plughole. This vortex is chaotic, fluctuates, yet it remains in shape as long as there is enough water to maintain the pressure, thus manifesting a new and complex energy structure. This is a state far from equilibrium, and is unpredictable, as is seen when the water pressure changes and the water returns to its normal state.

The well-established Second Law of thermodynamics (entropy), which states that any isolated system will eventually run down as it dissipates free energy, is not applicable here as the systems in question are neither isolated nor closed. A constant flow of energy, matter, and information characterises systems in the third state, thus not only producing negative entropy, but also infusing them with rich energy-flows that push towards non-equilibrium, greater instability, and increased complexity (Laszlo, 1992). As empirical research has shown (Prigogine, 1977; Laszlo, 1991), open systems exposed to constant energy flows become more structured and complex as the system is able to organise and structure itself by making use of, and storing, the increasing quantities of free energy rather than seeing the energy lost through entropy. This ability for a system to self-organise and structure itself comes from cyclic internal feedback, as Jantsch had previously explained in *The Self-Organizing Universe* (1980). Since such feedback cycles are responsible for the emergence of complex structures that form living systems, they are often referred to as catalytic cycles. Catalytic cycles are the key to understanding how living systems, as well as ecosystems and social systems, 'constantly bring in, break down and make use of energies found in their environment.' (Laszlo, 1985, p.7) It is these feedback cycles that are also responsible for repairing and regenerating systemic functioning.

The amount of free energy density, Laszlo tells us, is found in greater amounts as open systems increase in complexity. Open systems allow energy to flow through, and to be stored, which in turn creates more energy available for the shift towards greater complexity. Thus, systems far from equilibrium evolve into states of increased complexity and instability as part of a basic direction in evolution. The earlier view, made popular by French physicist Jacques Monad, that evolution is mainly a product of accidental factors, has been widely challenged since the 1980s as 'many scientists have become convinced that evolution is not an accident, but occurs necessarily whenever certain parametric requirements have been fulfilled.' (Laszlo, 1991, p.110). Given adequate time, says the theory, and a constant flow of energy within parameters of intensity, temperature, and concentration, then the basic self-regulatory cycles within self-organising systems tend to lock together in what is called higher-level ‘hyper cycles’ (Laszlo, 1991, 1992, 1994, 1996). Laszlo identifies this process as *convergence*. Convergence then is a process whereby dynamic systems are enabled to emerge into successive levels of higher organisation by a combination of lower cycles. In this behaviour we see a resemblance to a form of co-operation, or symbiosis. This correlates to what some scientists have observed in biological evolution whereby such organisms as bacteria and nucleated cells evolved through long-tern symbiosis and co-operation rather than through struggle and conflict (Margulis and Sagan, 1986).

In short, smaller systems combine to form larger ones. This process is the one that informs the hierarchical view of evolution as discussed earlier in this chapter. Laszlo summarises this process as follows:

> Progressively higher levels of organization are attained as catalytic cycles on one level interlock and form hypercycles: these are systems on a higher level of organization. Thus molecules emerge from a combination of chemically active atoms; protocells emerge from sequences of complex molecules; eukaryotic cells emerge among the prokaryotes; metazoa make their appearance among the protozoa and converge in still higher-level ecological and social systems. (Laszlo, 1994, p.114).

The explanation of the dynamics of complex systems given above, although admittedly free from hard scientific equations, gives us a broad overview of the development of evolutionary processes. This then answers the first question set: why it is that evolutionary processes drive themselves towards greater complexity in structure and function. We know that it is because open systems, which have a constant flow of energy and matter, are able to store energy that in turn is used to increase a system's organisation. This then leads to a series of systems converging together to form a larger integrated system that again repeats the converging cycle over again, thus always moving towards ever more complex integrated systems. The second question - what events influence the trajectory of hierarchically evolving systems? – requires us to examine the process of bifurcation.

Bifurcation

From the concept of emerging complexification of hypercycles through convergence, it has been seen that the hierarchical process of evolution moves through organisational levels. Since nonequilibrium thermodynamics is also known as the thermodynamics of irreversible processes then it suggests that systems operating far from equilibrium are on an irreversible trajectory (Prigogine, 1977). It has also been explained above that 'evolution moves from the simpler to the more complex type of system, and from the lower to the higher level of organization.' (Laszlo, 1996, p.37). However, since dynamic systems operate in Prigogine's third state, far from equilibrium, it also suggests that systems in this state are not entirely stable. Furthermore, as systems become progressively more complex they display behaviour that shows them to be more vulnerable to change and perturbations in the environment. In other words, they react more noticeably to small external fluctuations. Systems far from equilibrium maintain themselves through constant flows of energy, matter, and information that is regulated through internal feedback loops. Yet such systems also operate within thresholds of stability. If these thresholds are breached, then critical instabilities occur within the system. These instabilities are often caused by changes in the environment, which is crucial to self-organising systems, and such changes are liable to produce degrees of indeterminacy and chaos within the system (Laszlo, 1991; 1996). The emergence of chaos into a system is marked by the presence of fluctuations. Fluctuations, or oscillations, are more noticeable in complex systems sensitive to internal change, which in turn stimulates further instability. Such instabilities, if not righted, can lead to the breakdown of the system and its eventual collapse. However, a system that is unable to maintain its stability within its present structure has an alternative other than breakdown: this is known as bifurcation.

Bifurcation (from the Latin *bi*, meaning two, and *furca*, meaning fork) literally means a forked split into two. As a scientific term it refers to the behaviour of complex systems when exposed to high degrees of stress and instability, and characterises the leap into a new steady state. Dynamic open systems in the third state (far from equilibrium) do not evolve in a smooth linear path but through destabilisations and periods of chaotic activity before a new steady state can be found. Complex systems that are far from equilibrium have a greater variation of steady states to choose from, and so the outcome is never wholly predictable as the choice is not predetermined. In other words, the more stable the system, the more predictable is its next move. Just as with our friends whom we have known for a great many years we may feel that we can safely predict what their choice of alternatives will be. However, with a complex and unstable system (or friend) its choice of the next state to move into is largely unpredictable. Although having multiple new steady states as an alternative, the system can only ultimately choose one outcome. Thus, the system bifurcates, retaining the semantic accuracy of the ‘two fork’ metaphor. This can be imagined if we are taking a walk in a forest and our path reaches a crossroads. We cannot turn back for the path home is closed to us; therefore we must choose one of the several paths before us. Although there are various alternatives we can ultimately only choose one: our path then bifurcates and we move onto a new trajectory unpredictable to us before we came to the crossroads. Bifurcation then means the leap from the present unstable state to a new steady state. If the system does not bifurcate, it must either maintain its present state through internal feedback, or it will breakdown and collapse.

As the processes of nonequilibrium thermodynamics are irreversible (Prigogine, 1977), the only alternative to the system, other than total breakdown, is to evolve into greater complexity. In this way, it can be said that the systems theory of evolutionary processes view systems as being attracted to states of ever increasing complexity that move from states of instability to new steady states, and towards instability again as complexity increases. Further, that evolution is not a linear process but is rather forced into its trajectory when changes and perturbations in the environment of a system create conditions of chaos and instability. In this way evolution is a process of ‘sudden leaps that intersperse relatively extended periods of stasis.’ (Laszlo, 1986, p.276). Chaos then, rather than being an unwelcome guest in the house of science, is seen in this new light as being a required state for the further evolution of complex systems. In fact, chaos ‘is not the opposite of order but its refinement: it is a subtle, complex, and ultrasensitive form of order.' (Laszlo, 1992, p.243). It is this understanding that has spawned the emerging field of chaos theory, which itself has prompted the emergence of the sciences of complexity as an accepted area of scientific study (Gleick, 1998; Waldrop, 1994).

It may also be worth pointing out here that the bifurcation model of evolving systems has similarities with the *paradigm shift* theory published in Thomas Kuhn's *The Structure of Scientific Revolutions* (1996; 1st edition 1962). Here, Kuhn notes how advancement and progress is not a smooth, linear process but rather occurs when the existing stability of accepted thought is destabilised by the perturbations caused by emerging anomalies. In order to regain stability, the anomalies that can no longer be ignored or excluded form the core of the new body of accepted knowledge, thus affecting a 'jump' to a new paradigm.

In biology too we have parallel findings. US palaeobiologists Stephen Jay Gould and Niles Eldredge in their seminal study 'Punctuated Equilibria: An Alternative to Phylogenetic Gradualism', first published as a paper in 1972, described how evolution occurs not as a smooth process but when a dominant group within a species is environmentally destabilised and overtaken by subspecies on the periphery (Eldredge, 1985). Again, we witness the 'jump' feature being placed within the body of neo-Darwinian biology.

The second question that was posed - what events influence the trajectory of hierarchically evolving systems? – has now been elucidated. In brief, environmental changes and disturbances force systems far from equilibrium to make a leap to new steady states of increased complexity in order to avoid breakdown. The outcome, whilst unpredictable, does allow for order within an increased complexification that is more sensitive to chance instabilities yet more dynamic than previous states. Thus, it is through such ‘phases of chance and indeterminacy that evolution tends in the observed general direction of successive levels of organization, with growing dynamism and increasing complexity on each of the organizational levels.’ (Laszlo, 1996, p.40). The next step then for us to examine is the type of possible bifurcations.

Bifurcations, according to Laszlo’s GET, come in three types: subtle, catastrophic, and explosive. Subtle bifurcations are relatively smooth and continuous; catastrophic ones exhibit an abrupt transition as a result of mounting stress; and the explosive type where sudden factors wrench the system from its present state (Laszlo, 1991, 1994). Catastrophic bifurcations, it seems, are more appropriate as models for social and historical processes as they manifest a shift to a new state after a noticeable period of environmental fluctuations, albeit of the disruptive kind. It is with the social process aspect of Laszlo’s model that this thesis is particularly concerned with. GET is applicable within the four major realms of evolution: matter, life, society, and mind. For our purposes here it is enough to work with the evolutionary model of society.

The Direction of Social Evolution

The idea that the laws governing the natural sciences may be applicable to social systems has, as has been shown in Chapter One, been around at least since the emergence of Darwinian theory. What the latest application of systems theory now proposes is that the same parameters that guide the evolution of matter and life are also the guiding game rules for sociocultural evolution. It should be noted here that societal evolution follows its own path, drawing upon the concepts of the natural sciences, and as such does not operate on the level of being mere biological reductionism. With this in mind an important question to address early on is whether the general direction of social evolutionary change is determined. Taking as our model what was said previously about the processes of evolution leading to progressive complexification and increased instabilities, let us place this against known historical records.

Although a dramatic oversimplification, recorded history shows that human societal structures have developed from a nomadic tribal-based grouping, to settled communities with husbandry skills, then to feudal systems of specialised role positions, to the modern complex structures of economic and political states. This directional change, argues Laszlo, is driven by the amount of free energy entering the system. As previously discussed, self-organising systems use the flow of free energy to maintain their stability, and make use of available stored energy to undergo convergence into hypercycles, and thus increase their overall pattern of complex relationships. The degree to which open systems have the capacity to fuel their self-organisational processes is thus proportional to the available amount of free energy entering the system from outside. The more free energy that is available to the system the greater the complexity, which is the driving process behind GET.

This bears similarity to the work of Niklas Luhmann who, in his book *Social Systems* (1995), claimed that social systems regulate themselves through monitoring information coming from external environments. Luhmann also understood this energy to be, in the case of societies, information that is managed by social systems in order to become more autonomous and independent. This concept of energy as information will be returned to later in the thesis, as it becomes an important factor in modern information economies. The discrepancy between Luhmann and GET is where Luhmann sees social systems as moving towards reducing complexity rather than towards an increased complexification.

In the case of the development of human societies 'the factor that enabled societies to access and consume ever more free energy can be identified as 'technology'.'(Laszlo, 1992, p.245). Laszlo sees technology as that which facilitates greater interaction between humankind and nature, thus allowing greater access to the resources of nature making technology a major agent for stimulating social change. Thus, technology is 'the instrumentality for accessing and using free energies in human societies for human and social purposes.' (p.245). Laszlo is cautious to add that the technological impact on society is proportionate to the flexibility of its dominant modes and the ability for the society to adapt to such innovations. (Laszlo, 1996). Again oversimplifying, and using Laszlo's summary breakdown, we see a shift from the

Palaeolithic Age of kindling and limited use of fire, along with simple hand tools, to the Neolithic era where more sophisticated tools such as saws, hammers, and sickles came into use. Later, when agriculture became the main form of a stabilised community, the progressive development of metallic tools – copper, bronze, iron, appeared. Except for the transference from iron to steel the 8,000 years from the Neolithic era to the Industrial Revolution saw little in the way of dramatic innovations in basic agricultural tools (Laszlo, 1992).

However, there has been noticeable change in societal organisation during the last 1,000 years as the 'effects of technological innovations have been amplified by rapid means of transportation and communication and exported by dominant economic powers and conquering armies.' (Laszlo, 1986, p.279). Empires sustained themselves for centuries, especially those along fertile river stretches (Nile, Tigris-Euphrates, Huang-Ho) yet were also sites of tremendous fluctuations and destabilisations. Technology in the Middle Ages enabled multiple wars, personal and private conquests, and the repositioning of various belief systems through dominant local social structures.

The increased assimilation of technological innovations within society helped pave the way towards scientific investigation and the socio-cultural bifurcation of the Enlightenment. This major cultural shift, and later the printing press and the Reformation, allowed greater individual thought and internal social dynamics. With the advent of steam the Industrial Revolution triggered a radical upheaval in working, living, and production practices that revolutionised modern society as we know it. Using Laszlo's model we are able to see that there is a pattern in these historical processes. Namely, that technologically driven social change comes on the wave of increased energy consumption:

> With each technological 'revolution', more energies began to be accessed, stored, and used than had been in the preceding epoch…On the whole, technological change is irreversible: whatever the nature of a technological revolution, it is always from the hoe to the plough, and not the other way around…Improvement generally means greater efficiency in the use of energy, materials, or information. It means greater speed, less investment of time and money, and operation on a larger scale. (Laszlo, 1986, 280).

Time's arrow for Laszlo is in one direction only. This may prompt us to see Laszlo as a technological determinist, yet it is important to recognise that the underlying factor is the access, consumption, and storing of free energy that drives societal evolution into greater structures of complexity. Technology is the facilitator that helps society to harness changes that drive historical processes. Neither is this a linear process: not all technologies adopted are the most efficient and may depend upon random environmental factors. A case in point is the adoption of the motor vehicle over steam power. When the Stanley Steamer and the four-cycle Otto engine competed for dominance in the United States, the steam engine was hit by an outbreak of foot and mouth disease that saw all water troughs along public roads to be removed to halt the spread of the disease. This resulted in the motor engine becoming dominant and being adopted for modern life (Laszlo, 1986). This has also been referred to as the 'lock-in' factor (Waldrop, 1994). What is being considered here then should not be confused with instrumental rationalism as Laszlo has repeatedly said that 'some technological inventions are never adopted, and those that are adopted are not necessarily the most efficient.' (Laszlo, 1986, p.281).

The brief and simplified explanation given above cannot give a justified account of the dynamics of social evolution. Yet it is able to point out two important factors; these being that, firstly, the complexification of social processes are aligned with the irreversible flow of increased availability of free energies. Secondly, that historical processes manifest long periods of little change interspersed with periods of rapid change. Such moments of rapid change, or revolutions, can often be as much disruptive as they are progressive, leading to breakdown as well as development. At such times, societies – as systems in far from equilibrium states – are sensitive to environmental perturbations and liable to socially bifurcate[2]. The presence of social bifurcations demonstrate that there is a pattern in history, as well as nature, in the evolution of order and complexity. In the correlation of this pattern Laszlo (1996) states that

> Just as organic species evolve toward the use of greater densities of a wider variety of free-energy sources in their environment, so human societies develop to access, store, and use in greater densities larger quantities of free energy through the ongoing improvement of their technologies. As a consequence societies, the same as natural systems, tend to grow larger in size, develop more intricate relations among their diverse components, and create more massive and flexible modes of interaction among them. (p. 125).

In keeping with the systemic nature of GET, the nature of a bifurcation can be an integrated convergence of factors, with technology, conflict, or economics being the

[2] The varieties of social bifurcations, as outlined in Laszlo's terminology (1991; 1994; 1996), include the results of incorrectly applied technological innovations (T); external conquests or internal socio-political conflicts (C); and collapsing local economic/social order (E).

most dominant triggers. However, it would be a weakness to see GET isolating one specific factor as the sole nature of the bifurcation, especially after espousing a systems theory approach to phenomenon. As a further point, there are also anomalies that cannot easily be categorised by GET, such as the introduction of disease. The Black Death, as an example, was an anomaly that, in killing over fifty million people, had great impact upon fourteenth-century society. Yet somewhere in this conflict we also have an economic consequence that further served to shift society toward change and amendment. In short, GET is an attempt to offer a model to interpret phenomena within an evolutionary paradigm of systemic complexity; it does not claim to be the only model.

This understanding of the processes of GET brings us to an important stage in social development. In the latter half of the 20^{th} Century society witnessed the shift away from high material energy inputs towards the more subtle energy form of information. With the advent of the network society (Castells, 2001), and the dramatically increasing sophistication of information communication technologies, society is ordering itself in ever more complex patterns of relationships and interconnectedness (Castells, 2002; De Kerckhove, 1998; Urry, 2003). This state is ever further from equilibrium and thus more sensitive to environmental fluctuations. It is also a new level of self-organisation. It is now to this topic, and in particular the influence of the Internet, that the remainder of the thesis will concern itself.

CHAPTER THREE

THE INFORMATION TECHNOLOGY REVOLUTION - THE INTERNET AND SOCIETY

I have previously outlined the context whereby technologies can be agents in triggering social change. I will now focus the scope of this thesis specifically onto information technologies, and the Internet in particular. With the term information technologies I include the development in microelectronics, telecommunications, both domestic and commercial, with particular emphasis upon computing and the Internet. What I intend to explore in this chapter is the growth of information communication technologies (ICTs), as part of the new technological revolution, and how information became the new language of innovation and development in this revolution. The chapter will then progress to exploring the context within which both the Internet, and the World Wide Web (WWW), developed and how subsequently the Internet has fostered patterns of social interaction that are moving towards more complex levels of social organisation. On this subject some insight will be given on how the Internet retains and organises its systemic functioning, and thus can be regarded as an application of Laszlo's model. Finally, a word will be said as to how the revolution in ICTs has fostered a new technology paradigm that is more illustrative of the epistemological thinking of the systems sciences and as such engages with discourses of complexity.

The idea that growth and development is not smooth and steady, but rather a series of uneventful stable states 'punctuated' by revolutionary shifts at rare moments (Eldredge, 1985) is shared by sociologist Manuel Castells. Castells (2001) sees the end of the 20th Century as being one of these rare moments: 'an interval characterized by the transformation of our "material culture" by the works of a new technological paradigm organized around information technologies.' (p. 28). The last two decades of the 20th Century is where Castells sees the major technological breakthroughs occurring: in materials, energy, medicine, transportation, and communication. Importantly here Castells, like Laszlo, considers the storage and use of information to be key:

> Furthermore, the current process of technological transformation expands exponentially because of its ability to create an interface between technological fields through common digital language in which information is generated, stored, retrieved, processed, and transmitted…unlike any other revolution, *the core* of the transformation we are experiencing in the current revolution refers to *technologies of information processing and communication*. (Castells, 2001, pp. 29-30). (Emphasis in original)

Castells (2001) continues by affirming that information has become the new primary mode of energy after the earlier coarser energy of steam, electricity, and raw materials that were the sources behind previous socio-historical revolutions. The information technologies are a transformation from earlier technologies in that they enable a functional interface, or involvement/participation, with the user. As such 'the feedback loop between introducing new technology, using it, and developing it into new realms becomes much faster under the new technological paradigm.' (Castells, 2001, p.31). In this way of thinking Castells views the new information technologies not merely as tools but rather as processes. This epistemological shift from substituting a view of the parts to that of the processes is one of the fundamental changes in thinking associated with systems science (Capra, 1985; 1996). The diffusion of the new technologies within society, with emphasis upon the Internet[3], has allowed people to foster a greater measure of control alongside their participation with such technology. In this way the human mind becomes a productive force and process in its involvement with technology rather than being a separate part to it. Castells (2001) views computers, programming, and communication systems as being 'amplifiers and extensions of the human mind.' (p. 31). Similarly Laszlo (1992) sees the new information technologies as supplementing the information processed by the human brain, thus exponentially increasing the rate of information growth. Thus, both Castells and Laszlo, whom we may reasonably assume are not alone, consider society to be now *information-intensive*. One area that should be looked at here concerns the growth and impact of information communication technologies (ICTs) on society.

The Impact of Information Technology

Although early 20th Century developments in electronic information technologies, such as the telephone and radio, were important stages, the modern revolution in electronics

[3] Castells (2002) gives the number of worldwide Internet users, in a September 2000 survey, as 378m.

– sometimes referred to as *the third wave,* after steam and electricity – sprang up during and immediately following the Second World War. Those people who were contracted by US and British military intelligence to work on code breaking, such as Alan Turing in Britain and John von Neumann in the US, were the names behind the new technological breakthroughs in microelectronics computing. The 'Turing Test' became established as a method by which to approach a methodology of programmable intelligence (a precursor to artificial intelligence studies at the Massachusetts Institute of Technology) by the feedback loop of question and answers. Von Neumann, a mathematician of outstanding repute, undertook to formulate an analogy between computer and brain functioning, and is generally credited with the invention of the first digital computer. These developments grew out of the field of cybernetics that, along with Norbert Wiener's pioneering work and Shannon and Weaver's 'Information Theory' (see Chapter One) helped to inaugurate not only the electronics industry but also influence the rise of molecular biology as a new paradigm of understanding the computation of the human genetic code. Thus, information had become the new language of discovery, and the 50s, 60s and 70s saw this as the central key behind an exploding information technologies industry.

The decades of the 1950s and 60s were times of intense competition between rival electronics companies to build the first viable computers for military and industrial use, with IBM and Remington Rand being two of the strongest competitors. Influential environmental factors at this time included the role of Western capitalism to prove its superiority over rival ideologies, as well as the display of the growth of nation states through technology. The ‘revolution within the revolution’ came about with the advent of the microprocessor in 1971 (Castells, 2001). From the 1970s onwards micro-computing power saw exponential growth, as the computer chip became ever smaller and increasingly more powerful. Such a phenomenon became informally known as *Moore’s Law* (named after Intel’s co-founder Gordon Moore), which stated that computer microprocessing chips double in complexity every two years (Huberman, 2001). Much of the development of the microelectronics and computing industry was military funded at a time when technological superiority during a Cold War climate was essential.

The birth of the Internet is no exception as it was a project set up by the Advanced Research Projects Agency (ARPA) in September 1969, the agency being formed by the US Defence Department in 1958 (Castells, 2002; Rheingold, 2000). The initial concept was to construct a ‘decentralized, flexible communication network’ to serve as ‘a military communications system able to survive a nuclear attack.’ (Castells, 2002). The leap of progress, or bifurcation, in electronics can thus be put down, using the GET model, to both a technological, and a conflict, type bifurcation, seeing the Cold War paranoia as a destabilising influence. This original idea had come in the form of a proposal from the Rand Corporation, a Pentagon-linked think-tank, to enable the continuation of communications under extreme conditions, thus enabling the US government to retain military, if not civic, command. ARPA set up its own computer network, known as ARPANET, as a means of linking people and sharing information between various research groups and centres working for the agency. Several leading academic universities became network ‘nodes’ or centres for ARPANET in 1969, this growing to 15 universities by 1971 (Castells, 2002). In 1975 ARPANET was placed in the hands of the Defence Communication Agency (DCA) in order to facilitate communication between the various sections of the armed forces. In 1983 ARPANET was transferred to research communication rather than military use (for fear of possible security breaches), and by 1988 the US National Science Foundation (NSF) began using what was now termed as ARPA-INTERNET for its academic scientific communications. Despite being decommissioned in 1990, the ARPA-INTERNET had already aroused such a stir that several private service providers came into operation to set up their own gateways, access portals, into the network system. Thus, the Internet with which we are familiar with today developed from covert military-based aims and assumptions.

Yet the Internet did not develop exclusively from the military and scientific ARPANET. During this time, as universities were continually existing as nodal points in the network, students were being encouraged to use their privileged access for experimental design programs. Thus, operating languages and systems were being developed and experimentally tested on the network to bridge gaps between dispersed users and varied research-based operating systems so as to enable a more standardised network language. In other words, varied groups working within the old ARPANET system were each individually attempting to create a *lingua franca* in terms of a standard communicable operating system that would be accepted by the whole. Working separately, without a central authority, the networking system was beginning to self-organise itself into an accessible and functional commodity, much like an autopoietic system (see Chapter One). Rheingold (2000) sees the 'accidental history' of the Internet as being based on 'visionaries and convergences'.

Bell Laboratories released the operating system UNIX to the universities in 1974, which was expanded upon by its users to create the communication network 'Usenet News'. Students at the University of California, Berkeley, experimented with applications to bridge the gap between the two operating systems, that of UNIX and ARPANET. These networks eventually merged to form the basic communication network system that today we call the Internet (Castells, 2001; 2002; Rheingold, 2000). Despite attempts by several of the large corporations to claim proprietary and user rights over the UNIX operating system, the Internet remained a relatively open and free source. This was achieved by users abiding by an unspoken commitment to preserve the Internet from any centralised control, despite there being no pre-arranged directives. It was as if the only momentum was for spiralling growth. Thus, any user who developed a new and improved operating system, such as the 'Linux' in 1991, was to publish the final result on the Internet with access to all other others. In turn, the user community would constantly amend and upgrade the latest development to evolve it in line with the expansion of the Internet. The original hackers were volunteers who sought to improve upon most programs published upon the Internet and to republish those amendments (Levy, 1984). As if in a positive feedback loop 'quality was maintained not by rigid standards or autocracy but by the naively simple strategy of releasing every week and getting feedback from hundreds of users within days, creating a sort of Darwinian selection on the mutations introduced by developers' (quoted in Rheingold, 2003, pp. 51-2). No one central authority was in control and yet the Internet system grew from simpler patterns of use and relationships to a more complex network of interrelationships. The idea of copyright or intellectual property rights was simply not embraced by the user community.

By using the terms of Laszlo's model we can see that information, as energy, is fed into the open system to fuel its self-organisation, and this information is again released into the user community, amongst the scientists, students, and academics who constituted the main users at this time. As a positive feedback loop, the released information would not be returned to its previous state, as would happen in a negative feedback loop, but instead the new fluctuations in progress would be seized upon and developed before being fed back into the evolving system. The earlier development in the complexity of microchips had enabled the bifurcatory shift to a more complex yet still unstable level of communication technology in the Internet. The new information input would then serve to push the seemingly chaotic yet ordered system towards a still greater level of complexity. To say that the Internet existed in Prigogine's third state, that is *far from equilibrium*, is shown by its constant unpredictability, flexibility towards adaptation, and the fact that even minor fluctuations or changes to its operating system would have a pronounced impact upon its working.

The Internet shows itself to be a 'self-evolving development, as users become producers of the technology, and shapers of the whole network', giving us 'a proven lesson from the history of technology that users are key producers of the technology, by adapting it to their uses and values, and ultimately transforming the technology itself.' (Castells, 2002, pp.27-28). Technology, as Laszlo informed us earlier, is adapted by society to aid in its increased efficiency, growth, organisation, and the storage and consumption of free energy. The Internet, as I shall explore later, is a technology that is affecting a change in the dynamics of social organisation and complexity. First, however, it is important that the World Wide Web (WWW) is placed in a social and intellectual context here.

The World Wide Web

It was principally the work of English computer scientist Tim Berners-Lee who created the WWW whilst working at CERN, the European Particle Physics Laboratory in Geneva. It was Berners-Lee's original plan to create a program that could locate, retrieve, and contribute to any source of information that was on the Internet, with an ever increasing complexity of connections and linkages, and to be able to pass this information on to any other user irrespective of type of operating system (Berners-Lee, 1999). In effect, what Berners-Lee envisioned was a connection and interrelation of information without borders in a non-linear weblike way:

> *Suppose all the information stored on computers everywhere were linked*, I thought. *Suppose I could program my computer to create a space in which anything could be linked to anything*. All the bits of information in every computer at CERN, and on the planet, would be available to me and to anyone else. There would be a single, global information space.(Berners-Lee, 1999, p.4)

In collaboration with colleagues Berners-Lee released the WWW browser, with CERN's governing permission, over the Internet in August 1991. In line with user etiquette and procedure, Berners-Lee allowed others to access, use, and comment upon the browser in order to aid its development. In the words of Internet veteran Howard Rheingold (2003) Berners-Lee 'simply wrote a program that worked with the Internet's protocols and evangelized a group of colleagues to start creating Web sites; the Web spread by infection, not fiat' (p. 52). Berners-Lee, by not placing any intellectual property rights upon the WWW, allowed other users to spawn their own versions to publish on the Internet. In true self-organising fashion, Berners-Lee responded to positive feedback to enhance his browser, and the Internet community co-ordinated themselves into a shared community that allowed free access to all browsers being published upon the network. According to Berners-Lee (1999) he saw the WWW as supporting the already existing structures of the family, institutions, and work. The WWW then could be seen as the next level in social convergence after localised groupings of social relationships.

This analogy can be placed alongside Laszlo's concept of convergence where smaller sub-systems of relationships (e.g. the family) converge, or come together, to form a larger system (e.g. the multitude of families in the web community) that operates on a higher level of organisation (e.g. on a transnational as opposed to a localised national level). The functioning of the Internet community will be explored further, and in more depth, in the next chapter as it forms the application of GET for this thesis.

As a way of concluding this chapter I wish to say a few words about how the recent revolution in ICTs has fostered a new technology paradigm that is closer to the epistemological thinking of the systems sciences. Or rather, to say that there has been a convergence in discourse between GET and the analysis of ICTs as they both display features of the move towards greater complexity. A central shift in technologies that has enabled a new paradigm to emerge is the moving from technologies based on the inputs of fuel energy (e.g. electricity) to ones based upon the input and flows of information (this, of course, does not neglect the fact that computers need electricity for their power supply). Or, as Negroponte (1995) calls it, the shift 'from atoms to bits'. Castells (2001) has characterised several features that constitute this shift to what he terms as the new network society. The first feature is that information is the raw material for the new technologies, which makes them, as the second feature states, more pervasive as technologies since human activity is itself based in information. The third feature refers to the *networking logic* of the new ICTs as the increasing complexity of relationships and patterns in information require a move to network processes for efficiency. A fourth feature is the flexibility inherent in the new ICTs, and their capacity for rapid adaptation. A fifth feature is 'the growing *convergence of specific technologies into a highly integrated system*…in terms of technological system, one element cannot be imagined without the other.' (pp71-2: emphasis in original). These features pointed out to us by Castells again bear remarkable similarity to ideas in the new paradigm of systems thinking, where processes and relationships take over from structure and parts. Further, by stating that 'technological convergence increasingly extends to growing interdependence between the biological and micro-electronics revolutions' (Castells, 2001, p.72) it can be seen that the interdisciplinary approach put forward by Laszlo is increasingly sharing the discourse of our sciences and technology. Likewise Kevin Kelly (1997) sees the new economy as being driven by the rules of an emerging network society, one based on 'connections rather than to computations' (p. 1). Kelly further states that 'the sustained vitality of a complex network requires that the net keep provoking itself out of balance. If the system settles into harmony and equilibrium, it will eventually stagnate and die' (p. 14).

GET, which claims an evolutionary model of development, in far from equilibrium states of ever-increasing complexity through convergence, would recognise these networking patterns of relationships as cyclic organisations of feedback. The new technological paradigm that is emerging sees information as operating within open systems of flexibility, adaptability, towards networked relationships based on processes and flows. These flows have been recognised by some theorists (Capra, 1996; Laszlo, 1996; Castells, 2001; Urry, 2003) as moving towards convergence into a more highly complex and integrated system, closer to a holistic epistemology than a mechanical one. As Laszlo states:

> the new information technologies can be seen to drive societies toward increasingly dynamic high-energy regions further and further from thermodynamical equilibrium, characterized by decreasing specific entropy and increasingly dense free-energy flows, accessed and processed by more and more complex social, economic, and political structures.
> (Laszlo, 1992, p.247)

In terms of the Internet, high-usage societies are seen as 'dynamic high energy regions' that have decreasing entropy (i.e. less decay) since energy is flowing both into and out from the self-organised system in the form of usable information. This leads to the access and process of information as being a trigger towards 'more complex social, economic, and political structures', as Laszlo claimed above. This theory of increasing social complexity also takes into account what Laszlo (1992) calls the 'two-pronged development': namely, that information technologies manifest 'the simultaneous "upward integration" and "downward diversification" of operative structures in contemporary societies.' (p. 248). For Laszlo, this sees his GET as also applicable as a social model. That is, where GET shows that the diversity of sub-systems lock together as a form of hypercycle, to create a more integrated yet overall simplified holistic system, this mirrors a society's functioning civil society. Here, a developed form of civil society manifests an overall efficient systemic operation whilst being composed of many smaller sub-systems of regulatory bodies that aim to adapt social organisation through feedback of information. Society then can be said to be upwardly integrated whilst downwardly diverse. This systemic behaviour, argues Laszlo, is operative throughout evolution in all forms, be it biological, social, or cosmic.

It is not being claimed here that the growth of ICTs gives evidence as to the truth of GET. However, what is being put forward instead is that the self-organising development of the Internet, and the WWW, gives an illustration of an application of GET. Whilst Laszlo's theory is agreeable for a systemic approach, it often lacks practical application, leaving it to be relegated to the theoretical domain. In this thesis I aim to present a more balanced rendering of GET by applying it within a social context. In this chapter I have attempted to show how the development of ICTs have led to a shift towards a technological paradigm that is more favourable to systems theory and to GET. In particular I have focused on the Internet as being a major influence upon the shifting patterns of relationships from parts to processes, and from structure to flows. In the following, and final, chapter I shall take the World Wide Web as my application and make an argument for saying that it displays the characteristics laid down by GET and that the WWW will be a predominant force in social evolution towards ever greater levels of global complexity and integration.

CHAPTER FOUR

WEBBING THE WORLD: THE *WORLD WIDE WEB* AS A COMPLEX SELF-ORGANISING SYSTEM

It was suggested in the previous chapter that our stage of technical innovations has brought us to a time where networking logic and the 'convergence of specific technologies into a highly integrated system' (Castells, 2001, p.72) are now features of the informational network society. Kelly (1997) sees the new economy as a networked 'information economy' and that 'information's critical rearrangement is the widespread, relentless act of connecting everything to everything else' (p.1). This critical rearrangement that Kelly refers to has been brought about largely by the Internet and the World Wide Web. As De Kerckhove (1998) points out, the Internet is a web of addresses, of nodes and places, whereas the WWW is a network of content. Since the 'linking of content is a second level of articulation of the network environment…the Web is an order of complexity beyond the Internet' (De Kerckhove, 1998, p.146). This final chapter then deals with using the Web as an application for GET and to show how the features of GET's complexity and non-equilibrium states can be applied to the growth and functioning of the Web. The chapter will begin by looking at some of the patterns of Web traffic before moving on to an analysis of Web communities and computer-mediated communication (CMC). The final part of the chapter will aim to show that whilst the Web serves as a complex upwardly integrated open system it also includes a downwardly diverse set of self-organising sub-systems, as applicable to GET.

One of the features of complexity is that within a non-linear system, order is maintained. Bernardo A. Huberman, an Internet researcher in Palo Alto, has been tracking Web traffic by millions of users over a number of years. Huberman (2001) has found that underlying regularities occur within the Web between the links of users and that these regularities can often be predicted by statistical mechanics. However, since the 'parts that make up the Web – sites, links added to them, or pages - can display complex nonlinear dynamics' then 'the only predictions that can be made about their behaviour are probabilistic in nature' (p.21). That is, although the system displays a certain degree of statistical order it is also, as a non-linear system, open to fluctuations of a chaotic nature. Saying this, Huberman (2001) has formulated a *power law* that can adequately describe the distribution between 'the number of pages per site, and also the number of links emanating from a site or coming to it. It is a robust empirical regularity found in all studies of the Web' (p.25). This surprising finding gives a degree of order to the surfing patterns of Web users, as Huberman explains that users self-organise their linkage to and from sites according to the busyness of the traffic; much like a car driver would take an alternative route during rush-hour traffic. This organisation of behaviour is not server-directed (i.e. technology-induced directionality) but appears to be a pattern of genuine user-response, or rather a social phenomenon. Further, as a Web site becomes more popular it adds on more links, and 'the more links a site has, the more visible it becomes and the more new links it will get' (Huberman, 2001, p.30). Such that a site will self-organise its growth through its connectivity with other linked sites. This, using GET, sees a sub-system being formed within the hypercycle of the overall Web through similarity in the content-driven traffic of its users. This characteristic of linking sites between like-minded content users enables the formation of clustered communities, thus leading to the self-organisation of many diverse lower sub-systems of social relationships being maintained within the Web. Its complexity of interconnections therefore manifest an order whilst simultaneously being open to random fluctuations, such as the sudden disfavour of a particular site and its subsequent mass boycott by a large number of Web users.

Tim Berners-Lee, the original creator of the WWW, has similarly recognised the emergence of mathematical properties on the Web:

> The Web exhibits fractal properties even though we can't individually see the patterns, and even though there is no hierarchical system to enforce such a distribution…The Web is starting to develop large-scale structure in its own way. Maybe we will be able to produce new metrics for checking the progress of society… (Berners-Lee, 1999, p.222).

Fractal properties, such as those observed in the now famous Mandelbrot Set[4] are central to the theory of complexity and chaos (Capra, 1996; Gleick, 1998). Another part

[4] The Mandelbrot Set, named after French mathematician Benoit Mandelbrot, is a mathematical structure of staggering complexity that is produced through relatively simple procedures. Thus implying that great complexity can result from relatively simple initial inputs.

of the Web's emerging structure is aided through such innovative software as Brewster Kahle's 'Alexa' program which uses 'collaborative-filtering-like' technology to create connections between various Internet sites based on user traffic (Johnson, 2002). Again, this builds up a network through the content similarity of the users. In effect, it is an autopoietic process whereby the users assist, through their behavioural patterns, in the growth of the network. Amazon.com, who acquired this software in 1999, uses it to let customers know that *customers who bought this book also bought…* in an effective marketing strategy of interconnectedness.

It appears that Internet Web browsing is manifesting patterns of user-traffic that, as an application of GET, are becoming complex and adaptive self-organising systems. As more energy, in the form of users, is entering a system and energy, in the form of shared and spread information, is leaving the system, then entropy is replaced by increased self-organised growth. Such clusters forming on the Web become known, in one particular terminology, as common pool resources (CPR). CPR groups on the Web are a modern form of how, in earlier times, land users would share the general village/town commons. The old conundrum of being too greedy for one's own gain would deplete the whole resource whilst being altruistic for one's own group may leave the commons open to another's gain, is equally valid in Web networking. However, whereby the earlier village commons were mostly exclusive to outsiders, Web communities are open groups, thus being more sensitive to the fluctuations of altruistic/selfish behaviour. By recent observations it would seem that Web-networked groups are proving successful by a means of self-organised peer groups (Rheingold, 2003). Elinor Ostrom (1990), who had conducted research into CPRs, argued that external authorities are not likely to be necessary for governance if certain features are present. Such features include the capacity for involved individuals to participate in modifying the rules; a system for monitoring members' behaviour undertaken by the community itself (peer pressure); and for sanctions to be applied by and for community members (Ostrom, 1990). The Web is showing itself to be a space where, under the right conditions, self-organised forms of collective action are able to exist as a means to create order within an increasing complexity of interconnections. CPRs are perhaps the early manifestations in what Ostrom (1990) calls the 'empirically supported theory of self-organising and self-governing forms of collective action' (p.25). At the same time, since collective action is more reliant upon group trust and peer-coordination, since they are not exclusive domains, the potential to disorganise and collapse is also present. In GET terms, self-organised forms of collective action may bifurcate into increasing complexity, or collapse into disorder.

An example of this in action is the website Slashdot.org. This, like many other early websites, was created by a young college student to share his ideas, news, and articles, with friends. As it quickly drew attention, and more members, the number of articles of inferior quality increased. The creator of the site, Rob Malda, devised a system whereby his close friends would act as moderators, rating each new contribution in accord with its merit of content. This would act as a filter, using a scale of –1 to 5, to let other readers know the quality of the material before deciding to spend their online time reading it. Thus, a form of peer self-regulation came into being. As is the nature of the Internet, word soon spread of the existence of Slashdot.org and within a year there could be anything up to 50,000 visitors a day (Johnson, 2002). By 2001 the community of Slashdot registered users was in excess of 300, 000 (Rheingold, 2003). At that level, Rheingold informs us, ‘there was no way to organise except self-organise’ (p.123). And this, adhering close to Ostrom’s features of CPR, needed to be undertaken by the entire community. The result was as follows:

> If you’ve spent more than a few sessions as a registered Slashdot user, the system may on occasion alert you that you have been given moderator status…moderators only serve for a finite stretch of time, and during that stretch they have the power to rate contributions made by other users, on a scale of –1 to 5. But that power diminishes with each use… Dole out all your ratings, and your tenure as moderator comes to an end. (Johnson, 2002, p.155)

Further, if other moderators rate and praise your own rating assessment then you can gain special privileges and are more likely to be chosen for moderation at a later date than someone who pulled in no praise, or was generally disliked. Those users who disagree with the style of content in these main newsgroups are encouraged by Slashdot to form alternative newsgroups, again peer-monitored, based on their own particular brand of content and opinion, thus expanding further. This is a form of community positive feedback and peer monitoring, which bears similarity to the cybernetic model of feedback in open systems and the feedback, outlined in GET, required for regulatory order. The convergence into a cyclic system, Laszlo (1992, 1996) reminds us, requires co-operation; likewise do CPRs.

Another popular example of this system in operation is on the eBay auction site, as well as the Amazon.com marketplace. Here user ratings are used to evaluate both buyers and sellers, as a way of monitoring value, honesty, and the 'community spirit' so that other users can use this information on which to base their online decisions (Johnson, 2002). And on the Web, bad news and reputation spreads faster than the good. Reputation, according to Rheingold (2003), is where we see technology and co-operation converging. E-commerce, likewise, trades billions of dollars on trust (or rather as capital risk) and regulated open access (Castells, 2002; Rifkin, 2001). That which is bad news, such as fraud, cyber-espionage, or something as spectacular as the Barings Bank debacle, signals immediate feedback amendment; or collapse.

A third example of the emergence of a self peer-monitored collective is that of the 'Pretty Good Privacy' scheme (PGP) whereby users set up a linked chain of trusted fellow users using a form of digital signature verification to allow access of each others' files (Berners-Lee, 1999). This system, being coined as a Web of Trust, would, it is hoped, self-evolve in the same way as a person makes connections in everyday life, building up our own trust with individuals and organisations. Ultimately, 'the Web and the Web of Trust will be the same: a web of documents, some digitally signed, and linked, and completely decentralised' (Berners-Lee, 1999, p.167).

Finally, as a fourth example, we may refer to the rapidly growing file-sharing resource community amongst Web users, now being called 'Peer-to-Peer' computing (p2p), or 'distributed processing' (Rheingold, 2003). Although it is the music file-sharing Napster program that has been in the public spotlight in recent times, due to the major lawsuits brought against it by the recording industry, the sharing of computer memory by fellow users has been underway for a number of years. Here, users share space on their central processing unit (CPU) with others so as to enable more people to pool and exchange data and have increased resource power. Again, users monitor each other by reputation and reciprocal sharing, giving non-access sanctions to the 'free-riders' who refuse to share their CPU in return (Rheingold, 2003). Recently, this CPU sharing, or distributed processing, has evolved into a more complex form.

The once privately funded Search for Extraterrestrial Intelligence (SETI) project is a scientific examination of radio signals in space in search of extraterrestrial communications. The SETI's own servers based at their headquarters in Berkeley, California, were only able to download small segments of radio telescope signals at any one time. Thus, with the universe as your field of study, progress of analysis was inevitably slow. The answer came from former Berkeley student David Gedye who proposed an idea to link people's fascination with both space and the Internet. Home-users could offer their own CPUs as contributing computer power by downloading the SETI client software program free from the Internet (Rheingold, 2003). In this way, whenever the home-user's computer was idle, be it for seconds between use or overnight, the SETI software would activate its analysis, becoming dormant again as soon as the user returns to the keyboard. With millions of participants the computational capacity is staggeringly high. With the high level of complexity needed for the SETI program, a bifurcation in Web community networking emerged. This hypercycle of shared networking is beginning to expand to other areas of research. For example, the

National Foundation for Cancer Research and the University of Oxford used a similar technique whereby they asked for volunteers to offer their free CPU space to evaluate Oxford's database of 250 million candidate molecules for potential leukaemia medicine. With the assistance of 1.35 million online users the complete dataset was evaluated in just four weeks rather than several years (Rheingold, 2003). Obviously, such philanthropic use of the newly emerging hypercycles of open web systems has enormous future potential, as well as risks.

As the fuller picture is beginning to emerge we are seeing the Internet as a hypercycle containing many 'downwardly diverse' smaller open systems trading on information that is regulated by group peer monitoring. Such smaller systems also have the capacity to bifurcate and converge into larger networked cycles when the need for greater computational (information) power is required. This behaviour models what GET refers to as a convergence to a hypercycle, or higher systemic level of complexity. As was mentioned at the close of the previous chapter, the World Wide Web is able to serve as an illustration of an application of GET. Although this focuses on the applications that prove illustrative, and on the user communities that co-exist in relative harmony, there are more than numerous examples where the Web is being abused for such purposes as fraud, pornography, and illegal soliciting.

This thesis does not deny their existence, merely that in order to establish the aim here of presenting the applicability of GET to an analysis of ICTs, it is necessary to highlight those areas most responsive. Whilst GET is able to offer an explanation as to why processes develop through increased complexity, those that do not develop but break down are less visible in the long-term, yet within the scope of GET nonetheless. There are numerous examples, both within the Internet and social contexts, where components that have not successfully organised into efficient systems have ceased to evolve further and have stagnated or broken down altogether. Any collective, be it social or material, is open to aberrant elements. And those elements too require their own civil monitoring. Just as modern society monitors itself through civil bodies, so does the Web act as a complex system of interrelating cycles where agents and Non-Governmental Organisations (NGOs) can self-organise themselves into feedback roles. The potential remains, however, for such agents and NGOs to become disorganised; thus, becoming ineffective and non-evolving. Yet through these processes of constant regulatory feedback, the WWW has the potential to be a predominant force in social evolution towards greater levels of global complexity and integration.

The Web, like its parent host the Internet, is a playground for grassroots activity, and similarly benefits from innovative contributions towards a collective resource free from a centralised authority. Acts of co-operation and a freedom of speech are essential to the Web's growth, and grassroots players such as the original hackers have had an important role. As mentioned previously, the original *hacker* is not what we imagine today (the annoying intruder into our privacy), but was instead one of a number of like-minded individuals posting, amending, and re-posting software and operating systems onto the Net/Web to enable decentralised access (Levy, 1984; Rheingold, 2000, 2003). This idea of the Internet as being a commons for the public good has carried over into the Web and its CMC (computer-mediated communications) activists. Clusters of activists 'and NGOs are organisationally well-suited to benefit from the leverage offered by CMC technology and the people power inherent in virtual communities' (Rheingold, 2000, pp.276-7). Although initially forming smaller networked communities, the information can soon be distributed; thus widening the circle, forming more complex interrelated systems of collective action. There were enough online environmentalists in 1992 to support the creation of an online guidebook titled *Ecolinking: Everyone's Guide to Online Environmental Organization* (Rheingold, 2000). Today, human rights movements, campaigns against armaments, against rainforest destruction, and numerous other NGOs use Web organisation to gain widespread support and disseminate their message. Whereas before the Internet such NGOs had to lobby government for action, the Web has transferred activity to the people, thus allowing the parts of the system to have a greater responsibility and voice, whilst simultaneously maintaining the coherence of society as a whole. This process is much quicker and allows change to be more adaptive and responsive to changing needs (della Porta, Kriesi, and Rucht, 1999). This in turn affects how trade is achieved as Web activism and NGOs make capitalism increasingly transparent (Castells, 2002; Rifkin, 2001). Thus, as information flows into capitalism from Internet/Web activity, relevant corporate and national bodies are adapting through a form of self-organising response. This response returns as feedback to the NGOs responsible which is used, once again, as Web information flows; thus feeding the complex and dynamic structure that is Web society. The adaptive measures taken by corporate bodies, however, arise from different motivating factors as that of the general user and NGOs. Here, the Internet provides an opportunity for new market expansions and corporate gain. What may be seen as trust within a humanistic user-community is referred to as capital risk in E-commerce. In terms of GET, there is no prejudice when it comes to motivating factors. GET offers a model whereby self-organising systems may evolve into greater complexity and interconnection: if the presiding motivations for this adaptive organisation can maintain its systemic processes, it has the potential to evolve. This explains why those corporations that were slow to adapt to the global information age have shown themselves to be fallible and open to possible take-overs, mergers, or bankruptcy at worst. Complex processes then obey dynamics rather than motivations.

An example of Web activism in action was given by the Seattle anti-WTO protests of 1999. These 'anti-WTO protest movements…explicitly modelled themselves after the distributed, cellular structures of self-organizing systems' (Johnson, 2002, p.225). Smaller affinity groups had been called up through emailing on the Web, and their arrival, in vast numbers, in Seattle astonished even the authorities (Klein, 2000). Although their interests varied within the overall movement, they came together in their protests to create an action greater than the sum of their parts, despite their downward diversity. This is an example of how Web networking, following GET, can form into more complex, larger cycles that are maintained through a constant flow of information, are decentralised, and far from equilibrium. Here, it poured out from the virtual onto the social street. Klein, writing in *The Nation*, observed that 'what emerged on the streets of Seattle and Washington was an activist model that mirrors the organic, interlinked pathways of the Internet' (Johnson, 2002, p.226).

Again, it should not be forgotten however that such complexity of networked connections are open to breakdown as well as a bifurcation into more evolved and complex relationships. Just as a user-community can shift to a nationwide SETI program, it can also become destabilised through online viruses, illicit hacking, deliberate targeted traffic causing overload, and cybercrime (Castells, 2002). Another destabilising factor is deliberate misinformation, and the notion of Panopticon surveillance (Robins and Webster, 1999; Rheingold, 2000). The Web is sensitive to fluctuations that, presently, are aiding its growth, yet may also hamper and infect it, much like a brain tumour does to neuronal connections.

What this chapter has attempted to show is that an analysis of Web traffic, function, and content, can be applied to Laszlo's GET in that the WWW displays characteristics of a self-organising complex open system in a state far from equilibrium. Such features show a tendency for convergence towards ever more complex forms of systemic networks as the need for higher degrees of informational resource power increases. Also, with Web activism becoming more prominent and moving out into the social domain, I believe it gives credibility to the notion of the WWW becoming a predominant force in social evolution as we move towards ever greater levels of global complexity and integration. These implications will be given space in the conclusion that follows.

CONCLUSION

> *~ The macroshift moves toward a successful conclusion if, and only if, a critical mass of people in society evolve their mindset: if they generate and embrace values, worldviews, and ethics that mesh with the conditions that were inadvertently spawned by the technological innovations of their predecessors. ~*

The *macroshift* that Laszlo (2001) refers to in the opening quote is a bifurcation that occurs at a specifically complex level within a society's dynamic evolution. It is, says Laszlo, a 'bifurcation of human civilization in its quasi totality.' (Laszlo, 2001, p.9). Here Laszlo is bringing his ideas into a more humanistic and social context in addressing 'us' as a global society. The reference here is to a bifurcation on an unprecedented global level that relies upon a mass evolution of our current mindset that, as Laszlo implies, is a move from a Cartesian worldview of parts to one encompassing a connected wholeness. Such a move being triggered by our technical innovations. If we are to apply this analogy to Laszlo's GET here then this would refer to an emerging global society as a highly complex system. One that incorporates many lower sub-systems within it, in a far from equilibrium state, and maintaining itself as an open system by a continual flow of energy that is being used in self-organisation.

Further, Laszlo's 'two-pronged development' described information technologies as manifesting simultaneously both upward integration and downward diversification. This upward integration, as a social model, I had said was the hypercycle that could be seen as representing the most recent stage of our integrated society, whilst its downward diversification was its various civil self-organising bodies, such as NGOs. This structural organisation has been shown to exist in an analogy with the Internet and the WWW. GET then, as its name implies, is a general evolutionary theory that Laszlo sees as applicable to all forms of development, be they biological, material, or social, through continual processes of complexification. To quote Laszlo here:

> In sum, the processes of evolution create initially comparatively simple dynamical systems on particular levels of organisation. The processes then lead to the progressive complexification of the existing systems and, ultimately, to the creation of simpler systems on the next higher organisational level, where complexification begins anew. Thus evolution moves from the simpler to the more complex, and from the lower to the higher level of organisation. (Laszlo, 1991, p.112).

Modern technologies, and the arrival of ICTs, have fostered this trend towards ever-greater levels of complexity. A global society, connected by the Internet, is inherently more complex in its connectivity and relationships than a cluster of geophysical nation-states.

In GET terms, the Internet, with its computer-mediated communications, is the next level of complexification towards an ever more integrated human society. Thus, society has come a long way from its nomadic ancestry; from earlier forms of pastoral and agrarian social groupings to what we are beginning to witness today – an emerging globally cognitive society connected through information flows.

However, the limitations of this thesis must be acknowledged also. Our global world is not equal in its access to such technologies, and information flows can compress distances as well as enlarge them, according to the identity of the user (Urry, 2003). At present, access is not for everyone. Also, the Internet and the WWW, as a technology, is relatively new and still basks in its decentralised grassroots origins. How this will change, if at all it does, remains to be seen with time. The self-organising nature of the Internet, alluded to here by GET, may simply not happen if government censorship and Panopticon-like surveillance become a feature (see Robins and Webster, 1999). Also, due to the instability of socio-political processes, and to global conflicting belief systems, the Internet may prove to amplify such fluctuations rather than adapt to them. As Laszlo says:

> When a human society reaches the limit of its stability, it becomes supersensitive and is highly responsive to the smallest fluctuation. Then the system responds even to subtle changes in values, beliefs, worldviews, and aspirations. (Laszlo, 2001, p. 11)

Since the outcome of any bifurcation is initially undecided and is related to the nature of the fluctuations occurring within the system at the time, the above quote carries significant implications in that it shows how susceptible any future direction is to such unpredictable influences. Alternatively the Internet may ultimately only share certain features with Laszlo's GET and take on a different trajectory later in its continued development.

These things said I still feel that the Internet, and the WWW, share a discourse with GET that displays to a suitable degree, as this thesis was intended to show, that there is a relationship between science and systemic theory. Furthermore, that this relationship manifests in all aspects of life and may be taken by some as being a possible evolutionary paradigm of development.

To sum up, it has been the aim of this thesis to present Laszlo's General Evolutionary Systems Theory (GET) as a model that brings together knowledge from various fields, in both the natural and social sciences, to present a more unified understanding of evolutionary processes in nature and society. In this way an attempt is being made to offer a more holistic epistemological understanding. On this epistemological level, by combining the metaphors of the natural sciences with those of the social, we shall be approaching the phenomenon of life as interconnected in every sense. This understanding may prove useful to us if we are able to transfer it to the socio-political context of world affairs and to regard the complexity of our communication technologies as part of the continual process towards ever greater levels of global integration and human social evolution.

The future, as GET informs us, cannot be wholly predicted but will depend largely upon how global interconnectedness is developed, fostered, and embraced. The influences that are allowed to manifest today have the potential to become the influences of a bifurcatory tomorrow, and global ICTs have an important role to play in this. It is my hope that this thesis has gone some small way towards making this point.

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