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The architecture of the extended mind: towards a critical urban ecology

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The Architecture of the Extended Mind: Towards a Critical Urban Ecology

Jon Clendenning Goodbun

A thesis submitted in partial fulfilment of the requirements of the University of Westminster for the degree of Doctor of Philosophy

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The Architecture of the Extended Mind: Towards a Critical Urban Ecology

Abstract

This thesis is concerned with the difficulties that the discipline of architecture has encountered in thinking about and articulating ecological questions in recent years. I argue that it is precisely because the problems posed by the environmental question have so many personal, political and social dimensions, and are so radically trans-disciplinary, that architectural discourse and its metropolitan mediations is well positioned to reflect upon, articulate and stage as a new modern project, this multi-disciplinary and socio-ecological complexity.

The content of this thesis therefore crosses a number of different fields within the arts and sciences. I scrutinise a series of contemporary and historical moments in the development of systems thinking – or what Alfred North Whitehead described as “the philosophy of organism” – with particular reference to a socio-political re-conception of architecture, urbanism and the wider environment today. I describe a network of relationships which traces the surprisingly dynamic histories of a series of concepts – including nature, matter, organism, ecology, network, mind, emergence, system and dialectics – as they unfold across a wide range of disciplines, including architecture, cybernetics, Marxist theory, ecology and the cognitive sciences.

Ultimately, this thesis suggests that critical urban ecology – the architectural investigation of ecological aesthetics and urban political ecology – will be a key field of both theoretical investigation and practical design activism in the coming years, as the deep contradictions of capitalism unfold at an ever more intensified global scale.

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Author's Declaration

I declare that all the material contained in this thesis is my own work.

The Architecture of the Extended Mind: Towards a Critical Urban Ecology

Introduction

> The artist is prepared to look anywhere, into any discipline, scientific or spiritual, any view of the world – however esoteric or arcane – any culture, immediate or distant in space or time, in order to find ideas or processes which might engender creativity. There is no meta-language or meta-system that places one discipline or world-view automatically above all others. Syncretic transdisciplinarity informs artistic research at all levels. This is why we look in all directions for inspiration and understanding: to the East as well as the West; the left hand path as well as the right; working with both reason and intuition, sense and nonsense, subtlety and sensibility.[1]
> [Roy Ascott]

i.1 Process, Consciousness and the Political

This thesis is concerned with the difficulties that the discipline of architecture has encountered in thinking about and articulating ecological questions in recent years. To some, this might seem a somewhat controversial and unfair statement to make. Surely, it might be argued, there has been a great deal of important and useful work developed in response to the demand for more sustainable building practices – and to some extent this is indeed true. However, there remains a great deal of confusion about how to think and talk about these issues. More than that, it is often not clear to what extent these can be thought of as properly *architectural* responses, as opposed to actually being based within say building technology at one end of the scale, or social activism at the other. Nonetheless, in this thesis I argue that it is precisely because the problems posed by the environmental question have so many personal, political and social dimensions, and are so radically trans-disciplinary, that architectural discourse and its metropolitan mediations is well positioned to reflect upon, articulate and stage as a new modern project, this multi-disciplinary and socio-ecological complexity.

The content of this thesis therefore crosses a number of different fields within the arts and sciences. In this thesis I will assemble a series of contemporary and historical

moments in the development of systems thinking – or what Alfred North Whitehead described as “the philosophy of organism” – with particular reference to a socio-political re-conception of architecture, urbanism and the wider environment today. I describe a network of relationships, as an “ecology of ideas”, which traces the surprisingly dynamic histories of a series of concepts – including nature, matter, organism, ecology, network, mind, emergence, system and dialectics – as they unfold across a wide range of disciplines, including architecture, cybernetics, Marxist theory, ecology and the cognitive sciences. Writing in the mid-1980s regarding a different – although similarly trans-disciplinary project – Manfredo Tafuri asked:

> Architecture, language, techniques, institutions, historical space: are we simply lining up on a wire stretched over a void a series of problems, each with its own intrinsic characteristics, or can we legitimately contest the "terms" used here to trace these problems back to an underlying or hidden structure, in which these words can find a common meaning on which to rest?[2]

Whilst throughout this study I make repeated references back to architectural and urban themes, I also realise that this thesis speaks more broadly to a series of important and emerging contemporary discourses beyond any narrowly conceived study of architecture. Notably these would include (in no particular order) the various “new materialism” projects based in philosophy/cultural theory, discussions around the politics of the brain, the implications of extended and embodied cognition theory across cultural theory and the cognitive sciences, and the forms of critical and activist “metabolics” developing around urban political ecology.

In fact, I would say that the broad aim of this thesis, in this its final form, is to help situate a contemporary architectural, urban and ecological design and research practice within the new trans-disciplinary configurations of knowledge that are emerging from contemporary efforts to rethink the contradictions and boundaries between the natural, social and political sciences, and the arts and humanities. I have gravitated towards the concept of Critical Urban Ecology to describe the particular field of interest that concerns me here.[3] However, in its broad consideration of the conceptual and ideological histories of our conceptions of nature, ecology and complex systems, this thesis also addresses a

number of contemporary discussions in philosophy, critical theory and human geography.

Notably, this study makes a contribution to various contemporary attempts to construct more “vital” models of philosophical materialism. It also speaks to other attempts to re-conceive of the living, labouring, metabolically and cognitively embodied and extended human “subject”, which are themselves emerging in contemporary biopolitical accounts of the cognitive sciences. Lessons from disciplines as diverse as quantum mechanics, the cognitive sciences, ecology, and neocybernetics, show us that we really need to find very different paradigms for thinking about the unfolding dynamic cosmological and ecological reality of material processes, and our dialectical relationship to those processes as human beings, and as a key productive participatory part of, that reality. The sciences of complexity have all demanded a total revision in how we now conceive of matter and life, and what is meant by mind and self, and indeed what it means to be human. I argue that architecture, as a distinctively social form of material practice and knowledge, can stage a unique social reflection upon these issues as ecological questions.

Ilya Prigogine and Isabelle Stengers, whose seminal 1985 book on *Order out of Chaos* has become a landmark text for many neo-materialists, suggested that the new materialism calls for a study of “the timing of space”, and

> ... leads to a new view of matter in which matter is no longer the passive inert substance described in the mechanistic world view, but is associated with spontaneous activity. This change is so profound that ... we can really speak about a new dialogue of man with nature.[4]

Much of Prigogine and Stengers’ work focused on interpreting the dynamic and proto-metabolic structures of what they called far-from-equilibrium dissipative systems, examples of which pervade all living organisms, ecosystems and many complex “proto-animate” chemical reactions and physical processes. Reflecting upon their work, John Briggs and David Peat note – in language that resonates with neocybernetic and dialectical thinking – that a dissipative system “is autonomous (separate); its autonomy derives from its interdependence with its surroundings.” They go on to suggest that “the key to resolving this paradox is … how we understand words like ‘process’ and

‘relationship’. We are so used to thinking of ‘things’ that this may be difficult to grasp at first”.[5]

In just the last year or two, a series of interesting attempts to confront precisely these questions from a broadly critical theory and social science origin have been published. These include Timothy Morton’s *Ecology without Nature* (2010), and other neo-materialist formulations such as Jane Bennett’s *Vibrant Matter* (2010), Diana Coole and Samantha Frost’s collection of essays on *New Materialisms (*2010)*,* and Barbara Bolt and Estelle Barrett’s *Carnal Knowledge: Towards a New Materialism through the Arts (*2011)*.* These attempts are often based themselves upon modes of what Morton would broadly describe as paradigmatically “ecological thought”, by adopting the various relational network conceptions of material, biological and social actors that can be found in the recent work of Manuel DeLanda, Bruno Latour and a variety of texts inspired by the philosophy of Deleuze and Guattari (and which typically feature more or less substantial references to Whitehead, Spinoza, Leibniz and Marx). Most typically in these neo-materialist models we find attempts to theorise the fact that, far from human cognition being the sole source of reason in the world, it is matter itself – in both its most base and its various complex organised forms – which seems to require, at the very least, a much more sophisticated conception of perfomative agency.

There is a great deal that is useful in these writings, and in the attempts to articulate non-dualist accounts of the relationship between “nature” and “culture”; as such, these discourses echo my concerns here. Equally, however, many of the new materialist tendencies can tend to obscure the specific intellectual, political and economic conditions that have led to their own emergence today. The very materiality of the discourse, and the processes that it wishes to describe, has some difficult relationship with the increasingly complex and immaterial condition of contemporary capitalism. The emphasis on the “newness” of these new materialist accounts can forget that this is a discourse that has (in some versions at least) all kinds of roots in ecological, feminist and social constructivist critiques. There is an irreducible embodiment of social relations within any conception of materiality, and if traditional bourgeois distinctions such as “nature” and “culture” can seem increasingly problematic to us today, it is in no small degree precisely because

capital itself has penetrated into the very heart of the non-human world. As Tafuri again asks us,

> Is it still necessary to remember that the totality of the capitalistic means of production is a condition for both the cohesion and the diffraction of techniques, that the 'mystical character of the commodity' breaks up and multiplies the relationships that are at the base of its own reproduction?[6]

In this regard it is interesting to note that on the recent occasions where architectural thinkers have attempted to work through aspects of new materialist thinking, many of the same problems have remained unresolved and indeed often become amplified. This can for example be seen in the curious nexus that is emerging between aspects of new materialist thinking, attempts to theorise digital manufacturing technologies within construction, and so-called "post-critical" architectural theory, based upon a conception of positivist-empiricist-affective performativity, largely stripped of any historical, social and political dimensions.

Any new materialist project – whether in architecture or more broadly – must, I argue, incorporate our role as socio-political labouring participants, albeit situated within an unfolding cosmos of other relational material processes. At a time when the very concept of materialism is being so openly revisited by academics in a number of fields, it seems opportune to return – as I do in several chapters – to the broad question concerning a Marxian "dialectics of nature", and what John Bellamy Foster has described as "Marx's Ecology".

Importantly, I argue in this thesis that there is much that these projects – in their philosophical, architectural and ecological forms – can learn from the history of cybernetics. Indeed, as will become clear in the coming chapters, I concur with Bruce Clarke and Mark Hansen, when they suggest that:

> ... technoscientific processes ... are everywhere transforming the material world in which we live today ... Better late than never, second-order cybernetics can now perhaps finally come through on its promise to provide the ecology of mind best fitted to the demands of our intellectual, institutional, and global crises.[7]

Following this, I believe that a crucial contribution of this thesis is therefore to help position more clearly the relevance of thinkers such as Gregory Bateson, David Bohm and Francisco Varela to the development of a modern and more nuanced conception of materialism – one based upon an understanding of processes and relations unfolding through (and as) space and time, as much as objects. Importantly, by revealing the connections between this philosophical project, and an ecological conception of architecture and urbanism, it is possible to reveal the necessarily political dimension that any such project must take.

i.2: The development of this thesis

When I started this project, I had little anticipation of contributing to these broader discussions. The original aim of the thesis was to consider some conceptual models of the modern human being, in terms of a relational, networked and embodied self that "extended" out from our physical bodies. It was forms of this extended condition which seemed to be the "pattern that connected" much of the material that I was reading at the time. These sources included the "phenomenology" in the manuscripts of the young Karl Marx and the descriptions of "mystical" commodity networks in Marx's mature work, the mediated "extensions of man" described in the ideas of Marshall McLuhan, and the sense of a projective "body-space" felt by empathy theorists.[8] My interests however developed from the early years of this study, and were often mediated through design research conducted in practice and through teaching.[9] In particular, I became interested in post-war media and information theory, as well as more recent theorisations of prosthesis and interface – in particular the work of Andy Clark – which focused on understanding the way that the body co-opts and incorporates, in complex ways, tools of all kinds. It seemed clear that there was an opportunity to extend Clark's readings, to consider the way that buildings and cities acted as prosthetic tools. I had previously written about the way that some nineteenth-century German aesthetic philosophy – which had, in the accounts of Adrian Forty and others, played an important role in shaping how modern architecture thought about form and space – seemed also to speak directly to a contemporary "cyborg"

condition which we experience today. Most importantly, I saw this thesis as a vehicle to explore whether there might be architectural and urban readings of ideas that are developing in the cognitive sciences around extended and embodied minds, in biology around the concept of extended phenotype, in artificial intelligence research and psychology around the concept of pattern, and in ecology and neocybernetics regarding the co-evolutionary feedback networks that couple together organisms and their environments.

Much of my research during the early period felt rather esoteric and obscure at the time, and my exploration of how theories that can only be described as modern forms of panpsychism (the idea that all matter contains "mind"), pantheism (the idea that "God" is present in all matter) and hylozoism (the idea that all matter is alive), resonated with attempts to think about "extendedness" in its various forms, no doubt raised some eyebrows. Still, the fact remains that these cosmological network ideas can be traced not only in recent media theory (notably of course McLuhan), and in all kinds of ecological organicist philosophies and "new age" beliefs, but also Marx's account of commodity networks. I hence remain fascinated by the question of where this very specific spatio-ecological imaginary is coming from.

During the course of my research, such interests were shaped by a growing awareness and interest in the social, political, technical and theoretical aspects of the environmental question – both in terms of what is at stake in the demand for so-called "Design for Sustainability", and in ecological theory more broadly. As a result, Gregory Bateson – whose work was referenced in the original proposal with regard to media ecology and pattern theory – became a much wider influence than I had originally anticipated, and indeed, Bateson's work transformed my understanding of both ecology and cybernetics. More importantly, Bateson's thinking radicalised my appreciation of the possibility of developing new forms of science and technology as aesthetic and ecological systems of thought – and that this presented a fascinating opportunity for a new kind of architectural knowledge and practice.

It was notable that when I began this project I would generally be met with blank stares whenever I mentioned the name of Gregory Bateson. Today the situation is slowly changing. Beyond anecdotal stories of colleagues who are now looking again at Bateson's

work, a host of new publications, films and conferences demonstrate that his oeuvre is being taken up by theorists across a range of disciplines. This (still embryonic) return to Bateson is no doubt mostly characterised as an archival or historical project: recognising the scope and importance of Bateson's contribution across a range of disciplines, and his contribution to the development of many ideas that we are all familiar with today.

Some contemporary thinkers suggest that – important as it was at the time – much of Bateson's thinking has since been built upon or otherwise transformed by more recent research, such that his work *per se* is no longer so relevant to contemporary debates. Whilst of course I clearly see my thesis as a contribution to a broader examination of Bateson's ideas, I reject any purely archival interpretation of this material. Importantly, as I will argue, it is precisely some of Bateson's most difficult, obscure and trans-disciplinary ideas that are most valuable to thinkers today. Most notable perhaps, is his argument that – in a real and important sense – all material processes themselves are semiotic, in particular all highly organised and living material systems. By this he means that complex material processes, in so far as they are structured according to a responsiveness to relational differences in their surroundings, are language-like. In this regard – and in his corresponding call for an ecological aesthetics that is capable of transforming the very way in which we think about science and technology, and indeed architecture and design – I argue that Bateson's ecological-semiotic materialism has a vital contribution to make to contemporary debate.

While seemingly unconnected to any recent return of interest in Bateson's work, it is also the case that in recent decades the social geographer, David Harvey, has attempted to broker a discussion between Marxists and ecologists, suggesting that there is a great deal of common ground between these two bodies of thought. In particular, Harvey suggests that ecological organic philosophies – notably he refers to David Bohm, Fritjof Capra and Alfred North Whitehead – share much with a Marxian dialectical method based upon a philosophy of internal relations. This became an increasingly important proposition for me as my research progressed. I position Harvey's work in relation to similar thinkers and colleagues – Bertell Ollman, Neil Smith, John Bellamy Foster and Erik Swyngedouw – and consider in some detail the versions of organic and ecological theory by Bohm, Capra (and to some extent Whitehead) that Harvey refers to. Above all, my aim

is to extend Harvey's discussion to consider the relation between neocybernetics, complexity theory and a renewed dialectical materialism, and to consider what this means for thinking about architecture.

As I neared the completion of my thesis, Harvey himself began to disseminate a new, and I believe, highly significant thesis, which he calls "co-revolutionary theory."[10] Harvey's term clearly resonates with Bateson's conception of "co-evolution", which was further elaborated by Humberto Maturana and Francisco Varela, and later on by Niklas Luhmann – although Harvey never discusses these connections directly. Notably in his co-revolutionary theory, Harvey rejects the classical Marxian notion that class struggle alone is the primary motor of human history. Instead he proposes a more dialectical and systemic understanding – itself developed from some of Marx's comments in *Capital* and in the *Grundrisse*[11] – based upon a "method of moments" which involve a complex network of "mental conceptions", "relation to nature", "processes of production", "technology", "daily life" and "social relations". In the terms of neocybernetics, each of these moments develops autonomously, even whilst they are structurally coupled to each other and dynamically co-evolving as a network. Harvey argues that if you look at the conditions through which capitalism emerged, one can see this complex co-revolutionary development happening across these six kinds of moments. He goes on to argue that the left has failed to properly recognise such realities in its socio-economic theory, the result being that whenever it has attempted to affect change in practice – such as in the various twentieth century forms of so-called "actually existing communism" – it has worked on just one or two moments, and not as a dialectical movement across the whole system.

i.3: From the Ecological to the Neurological (and back again through architecture)

Over the course of the thesis I will thus move across all six of the co-revolutionary moments that Harvey (via Marx) has set out, although my material here speaks in particular to the moments of "technology", "mental conceptions" and "relations to nature". Moving across these three moments, my argument is that architecture today can be re-imagined – and indeed is increasingly re-defined by capital processes – as a social interface which lies between the ecological and the neurological. I argue that

developments that are underway in both the cognitive sciences and materialist philosophy, whilst still embryonic, have the capacity to transform what we think of as architecture. As such, they open a space for an expanded architectural knowledge that is based upon a more dialectical understanding of the way that environments – "built" and "natural" – are a part of the whole organism, and the way that human spaces become important parts of our extended minds and bodies. Developments in thought about matter are constantly being defined by what we are able to do with matter, and how we experience it. Architecture, which has for so long thematised our historical social relations to nature, might therefore today have a renewed task in contributing to thinking space, matter, energy and time, as a materialist form of semiotics that encompasses both human and natural orders. The city, which on this model is a highly particular form of organised matter and organic activity, is recognised as a political metabolic system operating within "natural" ecosystems that operate at both local and global scales. Today these natural ecosystems are structurally coupled to, and interrelated with, human metabolic flows. However, natural ecosystems have existed as processes independent of human interrelations before, and it is entirely possible that they might "adapt" to do so again in the future. It is the case then, that architecture has a dual relation towards the non-human world to articulate, a dialectical relation of both mutual autonomy and radical interdependence.

I will develop these ideas in greater detail through a series of specific analyses. In the first chapter on *A Relational Theory of Architecture*, I suggest that there is an important historical relationship between architectural knowledge, systems thinking and the very possibility of a "philosophy of organism". In particular I set out a specific understanding of space-time relationality and dialectical methods of thinking. Next, a chapter titled *Organon and the Production of Nature* is concerned with conceptions of the relationship between "culture" and "nature", and here I will consider the contested ideological and intellectual histories associated with such terms. In the third chapter *Dialectical Ecology: Towards a Critical Metabolic Materialism,* I look at ecological thinking more directly, bringing together both Marxian and neocybernetic insights in this regard. A fourth chapter,

Cybernetics and Systems Theory, reviews the history and legacy of cybernetics and systems theory more directly, and in particular I introduce the ideas of Gregory Bateson.

In these first four chapters, therefore, I trace the similarities and differences between a modern relational dialectics version of Marxism, and the methods of neocybernetics, and in so doing I position both in relation to contemporary discussions about new materialism. The next three chapters then deal with more specifically contemporary developments in the cognitive and ecological sciences. In the fifth chapter, *Ecologies of Extended Minds*, I set out the various forms of extended, embodied and ecological mind theory. A sixth chapter, *Bodies and the Timing of Space: The Architecture of Cognitive Mapping*, looks at recent developments within the cognitive sciences in the light of previous chapters, with particular attention to how we experience our bodies in space and construct our sense of self. In the last chapter, *Aesthetics, Technology, and the Spirit of Matter*, I will turn to consider the role that the concept of empathy has played since it was developed as a term in nineteenth-century spatial aesthetics, in thinking about our relations to our natural and technological ecological conditions.

I started this thesis as an open enquiry into the extended mind and relational thinking in its ecological, urban and architectural forms. The aim was to provide a critical historical, ideological and political account of terms such as “natural”, “organic”, “sustainable” and “ecological” – not of course, out of any climate-sceptic sympathy, but precisely because such an analysis shows that whilst these terms are the only concepts that we currently have to think through our contemporary environmental crisis, they are in many respects inadequate for the size and profundity of the job at hand. Nonetheless, I will conclude the study with some specific observations regarding congruences that are now emerging between the very different areas of research that I have considered. Most notably, I suggest that there is real work to be done to bring together urban political ecology, and the radical tendency within neocybernetics to create an ecological materialism. Thus in my conclusion I will also set out how I propose to take these issues on to future projects.

1. A Relational Theory of Architecture

1.1 Architecture and Systems Theory

Systems thinking in architecture is generally considered to be a twentieth-century phenomenon, beginning perhaps with the proposals for the rationalisation of the construction industry by Ernst May in Weimar Germany, or with the emergence of the French concrete industry as a system of prefabrication. In the post-war period, systems approaches to construction were taken up on both sides of the Iron Curtain – but to very different aesthetic and ideological ends. Whereas in the Soviet Union systems theory was taken on in the sense anticipated by May – that is to say, as a means of implementing *planning* – in the capitalist west it took on an apparently very different role, and was concerned with giving form to a society increasingly organised and valorised around networks of information. In the Soviet Bloc, systems models dominated construction methodology, but typically these were pre-cast concrete panel systems, which were heavy in every sense of the word. In the west a very different tradition emerged. In the United States, for example, through Eero Saarinen, the Eames, and most notably Buckminster Fuller, and in the UK through for example Archigram and Cedric Price, the implementation of systems thinking and cybernetics became associated with a particular form of techno-utopianism, and increasingly gave expression to an immaterialisation of construction.[1]

However, in this thesis I argue that all of the above are just a few moments in a much more complex relationship between architectural knowledge and systems thinking. In fact, the nature of architecture's engagement with systems thinking has been profoundly complex, in the full sense of the term: architecture is itself a system, even whilst it mediates other systems. It is complicit within the production of other bigger systems – economic, social, infrastructural – and is essential to the reproduction of smaller systems, most notably the human organism and human consciousness. In this thesis I will therefore link together a series of moments in systems thinking as it has developed over the past two centuries in particular. These moments are drawn together from across a number of disciplines, but are focused upon situations when practices and

Alberti: Architecture as an abstract study of whole/part relations

Figures 1.1 and 1.2. Leon Battista Alberti (1404-72), Santa Maria Novella, Florence, Italy (built from 1456 to 1470). Architecture (here specifically the facade) is theorised by Alberti as a *concept* which emerges as a *systemic relationship* between whole and parts: “Beauty is a form of sympathy and consonance of the parts within a body.” Alberti here suggests that beauty is a second-order effect, a self-empathy within an organism, between its parts. In fact, I suggest that one definition of architecture is *second-order building*, in cybernetic terms.

knowledge associated with architecture have engaged with, contributed to, or transformed themselves through, an engagement with systems thinking.

In this sense, architecture – which I broadly define here following Bill Hillier as human spatial configuration[2] – has always been engaged in, and mediated, the production and cultural conceptualisation of systems beyond itself. Whilst there was presumably little self-conscious reflection upon "architecture" as both an "abstract system", and a "system of abstraction" in the minds of the various builders of Stonehenge, for example, or in the collective historical activity of the countless generations who have anonymously contributed to human city building, by the time we get to the Renaissance this situation has dramatically changed. Here we find the emergence of modern architecture as a self-conscious professional knowledge and discipline, and we find it self-consciously theorising itself as a systems theory. In, for example, Leon Battista Alberti's theory of *concinnitas,* as set out in *De Re Aedificatoria*, we find, in the words of Adrian Forty, a "principle of harmony that underlies the graceful arrangement of parts in relation to each other and to the whole."[3]

I am suggesting here, in a sense in parallel to Tafuri's description of architecture's role in the ideological formulation of "the plan",[4] that in some sense *systems theory in general* was first imagined as a possibility, as a conceptual form, in this architectural moment.[5] Various conceptions of relationships between "parts", "fragments" and "wholes" will drive a lot of the discussion throughout the following chapters, just as it has done in modernity more broadly. If we find the part/whole dialectic in general to have been self-consciously articulated first (in its modern form) in Renaissance architecture, that is because – as Tafuri spent much of his career revealing – the Renaissance is "the space where the present finds its problems."[6] It is in this period that we find the birth of the system of modernity, and the birth of architecture as it is understood today, as both a systems discipline and, frequently, as a thoroughly ideological system of spatio-temporal projection.

Initially the spatio-temporal system that architecture projected was directed backwards, into an imagined classical past, and the system image was one of a harmonious socio-spatial organisation. However, there were contradictions inherent within this projection, not least that this ideal classical homeostatic image embodied in the ideal

city could not easily deal with *growth* as an urban reality or social ideology. As these contradictions started to unravel with the growth of capitalism, the temporal projection that was played out in architecture flipped, and became future-oriented. This is the moment of modernity proper: the conscious attempt to grasp the way that systems operating in the present conjure into existence “strange attractors” located in the relational space-time of the future. Growth is of course both an ecological and an economic concept. It is hugely significant, I suggest, that modern architecture became a site of a political struggle over the production and control of space and time, and as a systems discipline grounded in resolving an imaginary of whole/parts relations, within a context of growth.

In fact I would argue that since Alberti – and as William Braham and Jonathan Hale have shown, certainly since the Industrial Revolution – there has been a consistent re-engagement between modern architecture and systems theory, and a consistent attempt to define an architectural practice as a form of systems theory, articulated through various concepts articulated around nature, technology, organism and ecology. For Braham and Hale, the repeated engagements with systems theory in architecture must be comprehended within the context of their broader social and economic conditions, in which all aspects of architectural production were undergoing constant radical transformation. As a result, many architects

> ... tried many different formulations to manage and understand [these changes]... principal among them were various kinds of organic and biological analogies, which gained increasing precision as cybernetics, systems theory, and complexity analysis matured.[7]

Branham and Hale emphasise that at the same time as architects were attempting to understand the technological transformations of modernity, through developments in systems theory broadly, and biological thinking specifically, “those same developments were changing the understanding of organic life itself. In other words, as new paradigms of explanation develop they are applied equally to buildings, bodies and machines.”[8]

Some of the earliest examples of what we would recognise as contemporary systems thinking can be found surfacing throughout the nineteenth century, being drawn from spatial aesthetics, economic theory, and the nascent life sciences. These moments

of emergence are both very diverse and different, though often also interconnected – historically and conceptually – in sometimes important and surprising ways.

The twentieth century has been characterised as “the age of systems” by several theorists, notably perhaps by Ivan Illich.[9] The very apparatus of rational modernisation brought into being by the economic processes of capitalism did, through their inherent abstracting dialectic, make our reality a systems reality, in all kinds of ways. Inevitably perhaps, then, it is possible to trace the development of a series of competing and complimentary theories for understanding what systems are and how they work, throughout modernity. In the post-war period, cybernetics emerged as an important new trans-disciplinary mode of analysis. General systems theory – and more recently chaos, emergence and complexity theories – have all complimented this knowledge. Even in the humanities more broadly, structuralism and post-structuralism are in many respects based upon a systems analysis of language, emphasising that any part (i.e. word, sign or symbol) only has meaning through its network of relations with the whole of language. A major critical and trans-disciplinary history of the development of systems thinking – which would include significant contributions from the disciplinary histories of economics, dialectics, ecology, social sciences, aesthetics, cybernetics, general systems theory, communications and information theories, urbanism, emergence, chaos and complexity theories – has yet to be written.[10] Of course, such a history would, in all kinds of ways, mirror the development of that most systemic and trans-disciplinary of processes, capital itself. This project is not intended to be as broad in scope, but it does aim to make a contribution to this more general history of systems thinking.[11]

1.2 Dialectics and Systems Theory

One of the most important, and in various ways influential, forms of systems theory to emerge in the nineteenth century was a new configuration of the old philosophical concept of dialectics. This was effectively formulated in its modern form by Hegel and then adopted and adapted by Marx as a systems theory capable of grasping the complex system of capital. There has been much debate concerning whether dialectical analysis was considered by Marx to be broadly applicable as a scientific tool in general, and thus

whether he considered that dialectical analysis could be used to describe fundamental organisational processes and principles at work in space, time, matter-energy and life more broadly (as Engels certainly did). However, suffice it to say here that my general position is to consider the tendency of western Marxist theory – which has, since Lucaks' 1923 publication *History and Class Consciousness,* considered dialectics to be a tool of solely social analysis – to be mistaken. I broadly agree with recent thinkers including David Harvey, John Bellamy Foster, Richard Levins, Richard Lewontin, Bertell Ollman and Roy Bhaskar, who have all in different ways defended the possibility of a materialist dialectics (albeit no doubt from a minority position in contemporary critical theory.) Bhaskar for example notes that "while the evidence strongly indicates that Marx agreed with the general thrust of Engels intervention, his own analysis of capitalism neither presupposed nor entailed any dialectics of nature."[12] Without considering this issue any further here (although I will return to this question at several points in the coming chapters), the broader question remains: what is the relationship between dialectical thought, materialism and systems theory more generally?

Social Ecology anarchists such as Murray Bookchin and Alan Carter have both argued that dialectics is no more than a mystified form of systems theory.[13] From a different position, the biologist John Maynard Smith has argued that the development of systems theory has rendered dialectics obsolete, suggesting that Engels' "interchange of cause and effect" is in fact feedback, the transformation of "quantity into quality" is phase transition or threshold effect, whilst hierarchy theory covers the concepts of "integrated levels" and "overdetermination". Whilst I will agree that there is much in Engels' analyses of the natural sciences which directly anticipated much twentieth-century systems theory, there is more at stake than a question of which came first. As Mary Boger has argued, dialectics is distinct from systems theory, much of which can still be "fundamentally reductionist and static."[14] There are as we shall see important and large overlaps between different systems approaches, but also important methodological differences. Systems theory "interconnection" is not the same as dialectical "mediation", and, more importantly, variables in systems theory tend to be obvious, and not the result of abstraction as they are in dialectical analysis.[15] Perhaps the most interesting distinction to be made, it seems to me, is actually that in some sense Marxian dialectical method and cybernetic method

move in opposite directions. If Marx's method famously ascends from the abstract to the concrete,[16] neo-cybernetic abstracting processes move in the opposite direction. In the words of Clark and Hansen, "cybernetic methodologies draw out the virtuality correlated with actuality."[17]

Ultimately I concur with Richard Levins that there is scope and a need for systems analysis to be used as a "moment" in a dialectical analysis. Systems theories, as they have become increasingly important in natural, social and political sciences, have developed all kinds of valuable statistical, quantitative and management and policy-forming dimensions. Moreover, I think that it can be demonstrated that many aspects of complex systems, and in particular those requiring descriptions involving emergence, go beyond not only formal philosophical logic, but also recursive cybernetic logic, and can actually only be logically grasped without paradox within a dialectical framework (such as the debate over strong and weak emergence, which I return to at various points in the coming chapters). As Levins suggests:

> ... systems theory is best understood as reflecting the dual nature of science: part of the generic evolution of humanities understanding of the world, and a product of a specific social structure that supports and constrains science and directs it towards the goals of its owners. On the one hand it is a 'moment' in the investigation of complex systems, the place between the formulation of a problem and the interpretation of its solution where mathematical modelling can make the obscure obvious. On the other hand it is the attempt of a reductionist scientific tradition to come to terms with complexity, non-linearity and change through sophisticated mathematical and modelling techniques, a groping towards a more dialectical understanding that is held back both by its philosophical biases and the institutional and economic contexts of its development.[18]

1.3 A Dialectical Method: Space, Time and Internal Relations

Over the course of producing this work, one conceptual and methodological approach has come to prove particularly useful. This is the dialectical model of relational spacetime which David Harvey has outlined over the last thirty years. Whilst based in Marxist theory, Harvey's approach also innovates in some important ways. In the coming chapters I will

often attempt to use Harvey's position as a means of understanding a series of other ecological systems philosophies. This is not I think too controversial a move, as Harvey himself has noted that there is "a striking parallel between a relational version of dialectics (which has always been central to my own interpretation of the Marxian tradition) and many other forms of environmental discourses."[19] However, I do suggest that this project can be extended further than Harvey himself has had need to do, and that in fact his concept of a dynamic and process-based relational spacetime proves to be very useful in a number of ways. In fact, for me in this project, relational spacetime provides the core conceptual tool or metaphor that unites many different aspects (and chapters). For example, I suggest that it can be used to grasp something about the nature of pattern and information as it is conceived in cybernetics. I will also use it to structure my approach in thinking about the interaction between organisms (including humans) and their spatial environment, and the contribution that architectural-urban knowledge might make to a new ecological theory of extended mind.

"The idea of internal relations", Harvey states, drawing upon the work of Bertell Ollman, "is fundamental to dialectical modes of analysis."[20] This is the method that Marx developed from Hegel. According to Ollman, conventional thinking, in most academic theory and in the un-reflected experience of normal life, is that "there are things, and there are relations, and neither can be subsumed in the other."[21] This view might be called a philosophy of external relations.[22]

A philosophy of internal relations, on the other hand, attempts to define a subject matter through the relationships that this subject-object partakes in, as an integral component of the definition of that subject matter. For example, the conventional view of capital would be that capital is a thing ("money", perhaps) which has relationships with other things, and these relations are essentially external to the object. This is *not*, Ollman emphasises, Marx's account:

> Marx rejects this logical dichotomy and views capital as itself a complex Relation composed of its ties to other ... relations ... Moreover, since these relations extend backwards and forwards in time, this also makes what capital was, as well as what it is likely to become essential parts of what it is now.[23]

In fact, as Ollman goes on to argue, for Marx everything, “not only capital, is grasped as the sum of its relations.”[24]

A key point to grasp here is that this is not simply a question of shifting how we might re-conceive of familiar objects and processes, wholes and parts. The issue, rather, is to realise that the first task of any critical enquiry based upon this method is to define its subject matter in such a way as to encompass a conceptually (and politically) useful range of relations, in both space and time. To this point, Marx’s dialectical method might seem to have all kinds of interesting parallels with Bruno Latour’s actor-network theory (ANT). This process, of defining a relational set, as a subject matter, *is the process of abstraction*. It is this process that allows the dialectician to *see* what is obscured behind appearances. For Ollman:

> ... it is the philosophy of internal relations that gives Marx both the licence and opportunity to abstract as freely as he does … to decide how far into its spatial as well as its temporal relations any particular will extend.[25]

For example, he argues that Marx creates as subjects, and subject matter, “relations of production” and “surplus value”, both of which are new subject matters built out of a set of relations within the processes of capital.[26]

If a philosophy of internal relations and the process of abstraction are the core components of dialectical analysis, there remains the question of how one decides with which relations and which abstractions one should work? Ollman has described dialectical analysis as a process which is composed of six key moments.

The first is the ontological moment. This consists of acknowledging that the world, both social and material, is composed of a series of systems and processes. As I shall later discuss, this is not quite the same as saying that “nature is dialectical”, but it is saying that *what is* is susceptible to a relational systems and process analysis. Once we grasp reality as “an infinite number of mutually dependent processes that coalesce to form a structured whole or totality,”[27] the second moment then consists of organising our thinking in relation to such a world (and as a part of such a world): this is the epistemological moment. This requires a philosophy of internal relations, and a process of “abstracting out the main patterns in which change and interaction occur.”[28]

The third moment is one of inquiry, and involves developing categories which describe the patterns of internal relations as aids to investigation. The fourth and fifth moments concern representation and synthesis, presenting the results firstly to oneself as a moment of intellectual reconstruction and self-clarification, and then, in a moment of exposition, by “taking into account of how others think as well as what they know, one tries to explain this dialectical grasp of the ‘facts’ to a particular audience.”[29]

The final moment is one of praxis: based upon the above, “one consciously acts in the world, changing it, testing it and deepening one’s understanding of it all at the same time.” As a final moment it in fact contains as internal relations all of the preceding moments, and as such the process is repeatedly executed. This dialectical process, summarised below by Yrjö Engeström, is commonly referred to as:

> ... the dialectics of ascending from the abstract to the concrete. This a method of grasping the essence of an object by tracing and reproducing theoretically the logic of its development, of its historical formation through the emergence and resolution of its inner contradictions. A new theoretical idea or concept is initially produced in the form of an abstract, simple explanatory relationship, a 'germ cell'. This initial abstraction is step-by-step enriched and transformed into a concrete system of multiple, constantly developing manifestations ... the initial simple idea is transformed into a complex object, into a new form of practice. At the same time, the cycle produces new theoretical concepts – theoretically grasped practice – concrete in systemic richness and multiplicity of manifestations.[30]

There is then a fundamental politics at the core of how we even start to think about the world. “Reality doesn’t come with its boundaries already in place,” Ollman reminds us. It is, rather, up to us to define our own boundaries in the world, practically and conceptually. This is the essence of a dialectical systems approach, and it is this that I will attempt to do in this project, at a series of different scales or emergent levels. In consequence, I attempt to develop a definition of architecture on the basis of a philosophy of internal relations. This means, then, defining architecture as a series of extended physical, mental and social relations, in both space and in time.[31] The choice of boundaries and systems which might define architecture, and on which architecture depends, *is a political choice*.

It is in developing a dialectical conception of space and time as themselves relations that David Harvey's work has been particularly innovative, and important for parts of my project here. As Harvey emphasises, it is not simply that relations (for example capital) exist in space and time (although that is the case). It is not that space and time are just neutral containers or frameworks in which life and matter flow around. It is rather that space and time are themselves constituted and produced as relations, as social reality through processes such as capital – but equally, at a more fundamental level, through (and as) matter. This, then, does not just refer to space and time in a social or cultural sense (although this is Harvey's primary concern), but in the full materialist sense. Harvey usefully refers to several non-Marxist systems/process thinkers, notably Alfred North Whitehead, who suggested: "the determination of the meaning of nature reduces itself principally to the discussion of the character of time and the character of space."[32]

1.4 Relational Spacetime

Harvey argues that "if Raymond Williams were contemplating the entries for his celebrated text on *Keywords* today, he would surely have included the word 'space'."[33] Harvey first put forward his own conception of space in his 1973 *Social Justice and the City*. He has, however, consistently used and developed it ever since, and he has, it seems, returned to it in particular in recent years.[34] He introduces his approach as a matrix of relationships with two axes or dimensions of spatial analysis.[35] The first is taken fairly directly (and openly) from the familiar three terms of Henri Lefebvre: Material Space, Representations of Space, and Spaces of Representation.[36] "Material space" is space as we experience it through our sense perceptions. It is "the perceptual space primary experience mediated through human practices."[37] The category of "Representations of Space" describes the way that we conceptualise sensory experience of material space and time, through representations: words, diagrams, pictures and so on. Finally, the confusingly named "Spaces of Representation", or lived space, is the space of meaning and imagination in everyday life; it describes the "way we humans live – physically, affectively and emotionally – in and through the spaces we encounter."[38] If "representations of space" are projections of material space into a human cognitive order,

Space as a Keyword

	Material Space (experienced space)	Representations of Space (conceptualized space)	Spaces of Representation (lived space)
Absolute Space	walls, bridges, doors, stairways, floors, ceilings, streets, buildings, cities, mountains, continents, bodies of water, territorial markers, physical boundaries and barriers, gated communities…	cadastral and administrative maps; Euclidean geometry; landscape description; metaphors of confinement, open space, location, placement and positionality; (command and control relatively easy) – *Newton and Descartes*	feelings of contentment around the hearth; sense of security or incarceration from enclosure; sense of power from ownership, command and domination over space; fear of others "beyond the pale."
Relative Space (Time)	circulation and flows of energy, water, air, commodities, peoples, information, money, capital; accelerations and diminutions in the friction of distance…	thematic and topological maps (e.g. London tube system); non-Euclidean geometries and topology; perspectival drawings; metaphors of situated knowledges, of motion, mobility, displacement, acceleration, time-space compression and distanciation; (command and control difficult requiring sophisticated techniques) – *Einstein and Riemann*	anxiety at not getting to class on time; thrill of moving into the unknown; frustration in a traffic jam; tensions or exhilarations of time-space compression, of speed, of motion.
Relational Space (Time)	electromagnetic energy flows and fields; social relations; rental and economic potential surfaces; pollution concentrations; energy potentials; sounds, odors and sensations wafted on the breeze	surrealism; existentialism; psychogeographies; cyberspace, metaphors of internalization of forces and powers; (command and control extremely difficult – chaos theory, dialectics, internal relations, quantum mathematics) – *Leibniz, Whitehead, Deleuze, Benjamin*	visions, fantasies, desires, frustrations, memories, dreams, phantasms, psychic states (e.g. agoraphobia, vertigo, claustrophobia)

	Material Space (experienced space)	Representations of Space (conceptualized space)	Spaces of Representation (lived space)
Absolute Space	useful commodities, concrete labor processes, notes and coins (local moneys?), private property/state boundaries, fixed capital, factories, built environments, spaces of consumption, picket lines, occupied spaces (sit-ins); storming of the Bastille or Winter Palace…	**Use Values and Concrete Labors** exploitation in the labor process (Marx) vs work as creative play (Fourier); maps of private property and class exclusions; mosaics of uneven geographical developments	alienation vs creative satisfaction; isolated individualism vs social solidarities; loyalties to place, class, identity, etc.; relative deprivation; injustice; lack of dignity; anger vs contentment
Relative Space (Time)	market exchange; trade; circulation and flows of commodities, energy, labor power, money, credit or capital; commuting and migrating; depreciation and degradation; information flows and agitation from outside	**Exchange Values (Value in Motion)** Accumulation schemas; commodity chains; models of migration and diasporas; input-output models. theories of spatiotemporal 'fixes,' annihilation of space through time, circulation of capital through built environments; formation of the world market, networks; geopolitical relations and revolutionary strategies	money and commodity fetish (perpetual unfulfilled desire); anxiety/exhilaration at time-space compression; instability; insecurity; intensity of action and motion vs repose; "all that is solid melts into air…"
Relational Space (Time)	abstract labor process fictitious capital; resistance movements; sudden manifestations and expressive irruptions of political movements (anti-war, '68, Seattle…); "the revolutionary spirit stirs…"	**Money Values** Value as socially necessary labor time; as congealed human labor in relation to the world market; laws of value in motion and the social power of money (globalization); revolutionary hopes and fears; strategies for change.	**Values** capitalist hegemony ("there is no alternative"); proletarian consciousness; international solidarities; universal rights; utopian dreams; multitude; empathy with others; "another world is possible"

Figures 1.3 and 1.4 Harvey's expansion of Lefebvre's terms of spatial of production, taken from David Harvey, 'Space as a Keyword', in *Spaces of Global Capitalism* (London: Verso, 2006)

then “spaces of representation” are projections and constructions of the human subject itself.

In addition to these three categories which are set out along one axis, Harvey sets out along the other axis another tripartite division of space (which also owes a significant debt to Lefebvre), and which he terms as absolute, relative and relational:

> [I]f we regard space as absolute it becomes a ‘thing in itself’ with an existence independent of matter. It then possesses a structure which we can use to pigeon-hole or individuate phenomena. The view of relative space proposes that it be understood as a relationship between objects which exist only because objects exist and relate to each other. There is another sense in which space can be viewed as relative and I choose to call this relational space – space regarded in the manner of Leibniz, as being contained in objects in the sense that an object can be said to exist only insofar as it contains and represents within itself relationships to other objects.[39]

Absolute space, then, is materially constituted by “objects”: walls, buildings, continents. It is conceptually the space of Newton and Descartes, and absolute space is typically represented as a fixed and immovable orthogonal grid, and as being geometrically Euclidean. It is the space of planning and cadastral mapping: absolute space as a lived space might include the sense of security and ownership. “Socially,” Harvey notes, “absolute space is the exclusionary space of private property ... space of this sort is clearly distinguishable from time”[40]

If absolute space in capitalism is the space of private property, then relative space is that of monetary and commodity circulation. Space and time are therefore here connected into relative space-time. This is conceptually represented in the geometries and topologies of the relativistic space of Einstein and Reimann. It is the spatial form required to represent processes and flows, of energy, matter and money. It is important to recognise that just as absolute space is fixed, the fact that “processes produce their own space and time is fundamental to relative conception”[41] Because of this, it is not at all obvious how different relative space-times can be connected or compared, and recognising the choices in different relative representations highlights political choices.

Harvey suggests for example that the relative space-time needed to describe ecosystem flows is not currently compatible with the space-time of capital in financial markets.

Architects draw through plans, and this is also the space that property rights are generally described by. However, as anyone who has worked in construction, or even has just owned a house or managed a property knows, there are limits to what can be described in absolute space. Whilst a property boundary can be described as a line on a drawing, in practice on the ground it often needs to be negotiated through convention. If a boundary is in reality defined by a wall, and that wall is inevitably not completely straight, then there is already a process of relativisation. Equally, even on massive infrastructural projects which require extraordinary precision in surveying and alignment, such as large scale bridges, it is only in recent years with GPS satellite systems that something approaching an absolute space has been achieved. Typically, a local region of absolute space would be defined in accordance with local surveying. Cities and structures are still best understood as defining a series of locally defined absolute spaces, which are still, to some extent at least, positioned within a more fluid relative space.

However, whilst the “cities and structures” referred to above might be comprehended in absolute and relative terms, the metropolis – as not simply a “modern city” but rather a concept, a specific *historical form of abstraction,* that emerges under conditions of global capital exchange – can only ever be grasped in *relational* terms (the third term on this axis for Harvey). The metropolis is a new differential configuration of the terms of Material Space, Representations of Space, and Spaces of Representation: a configurational form with a distinctly immaterial “concreteness”. For David Cunningham,

> If therefore the metropolis presents itself as a form of (real) abstraction, and is only ‘unified’ as such, it still only attains ‘real existence’, and thus both specific and variable ‘form’ and ‘content’ – as, in principle, does any social space – by virtue of the spatial production of its open and dispersed totality of specific ‘material’ assemblages, its particular ‘bunches or clusters of relationships’, its own multiple transactions and contacts, which are in themselves highly differentiated, if always related to its general form. Indeed, without these it has no concrete form or determinate ‘meaning’ at all. But, by contrast to the earlier forms of what Lefebvre terms ‘absolute’ and ‘historical’ space – in which, as in the polis, the ‘incomparability’ of the intrinsic qualities of certain sites remains essential – ‘specific

> values' are no longer, in themselves, definitive of the urban as such, and are constitutively mediated by a pure form of exchangeability.[42]

Harvey's final category of relational space is then materially the spatial mode of field relations, and conceptually the enfolded space and time of Leibniz and Bohm. In this conception, "space and time are internalised within matter and process"[43] and are hence described as spacetime. Most importantly, Harvey suggests that "relational spacetime implies … the idea of internal relations, and this … is fundamental to dialectical modes of analysis."[44] As an example here, Harvey takes three terms that Marx develops in the first chapter of *Capital*: use value, exchange value and value. Use values are always in absolute space and time. Exchange values for Marx "break through" absolute space and time, and exist through a relative space-time (i.e. market networks). Value, however, Harvey asserts, is an entirely relational concept: it is "immaterial but objective." In fact, Harvey argues that "it is impossible to understand Marxian political economy without engaging with relational perspectives."[45]

As spacetime becomes more relational, it becomes less empirical and positivist (history is a relative temporal concept, whereas memory is relational; something which Harvey makes much of in his reading of Benjamin). Harvey notes that:

> ... external influences get internalised in specific processes or things through time (much as my mind absorbs all manner of external information and stimuli to yield strange patterns of thought including dreams and fantasies as well as attempts at rational calculation) ... certain topics, such as the political role of collective memories in urban processes ... can only be approached in this way.[46]

Clearly, then, for Harvey, "the three spatio-temporal frames must be kept in dialectical tension with each other,"[47] and (although Harvey is less clear about this) absolute and relative space are subsets of relational space (this seems plausible mathematically as well as philosophically). Even whilst in any moment of analysis priority might be given to any one mode, thought should be "prepared to range freely and dialectically over all the moments of the matrix simultaneously."[48] It is not then a question of which mode of space is more real ("is space absolute, relative or relational? I simply don't know whether there is an ontological answer to that question", writes Harvey)[49] but is, rather, a recognition of

the fact that “the problem of the proper conceptualisation of space is resolved through human practice with respect to it ... there are no philosophical answers to the philosophical questions that arise over the nature of space – the answer lies in human practice.”[50]

1.5 A Relational Theory of Architecture

Architecture, then, can be seen to have a profound relationship with systems theory. In an abstract sense, architecture as a discourse is a systems theory in itself, and in fact I have suggested, might arguably be thought of as the foundational systems theory (as in Alberti’s *De Re Aedificatoria)*. More than that, architectural discourse has often been supplemented by, or expressive of, other systems theories. However, it also has a concrete relation with systems theory, in that buildings and cities are systems, and are systems moreover which mediate, in concrete ways, other systems. To restate, the theories of architecture are in effect all systems theories (although not all are consciously so), but also the objects (or are they subjects?) of architectural theory (i.e. buildings, cities, spaces etc) are also systems. Given this condition, I suggest that a *relational* theory and definition of architecture, based upon a philosophy of internal relations, constitutes an especially interesting proposition. In fact, I would argue that it isn’t possible to coherently define architectural knowledge in any other way.

Architecture as a body of knowledge has a complex relationship with its object. Architectural knowledge is, in some professional sense, the *consciousness* of that part of building practice which consciously thinks of itself as “architecture”. However, architecture also – quite properly – considers its object to be a whole series of productive practices that are either unconscious building activities, or else are simply *spatial practices* in a much broader sense. To consider what architecture (and here I would include urbanism) considers to be its object, one need only look at what architects and architectural theorists *claim* this to be. Clearly today architecture ranges from interface design to the emerging urbanism and political ecology of developing mega-cities, from environmental technologies to the organisational management of corporations and brands, to design activism. Leon van Schaik has argued in a memorable phrase that “architecture

professionalised around the wrong body of knowledge," suggesting that rather than basing the profession around building construction, architecture should have professionalised itself more broadly around claims concerning *spatial knowledge and organisation*. There are of course problems with this formulation too. Nonetheless, van Schaik's suggestion seems to have some validity, especially when one reflects upon, for example, the recent moves by Rem Koolhaas and the AMO project in this regard – consider in this regard Koolhaas's statement that "maybe architecture doesn't have to be stupid after all. Liberated from the obligation to construct, it can become a way of thinking about anything."[51]

In the space-time terms that I have set out above following Harvey, buildings are – in a straightforward sense – a set of material objects located in an absolute space and time. However, buildings as material objects, and their representations, are also unavoidably located in a relative space. For example, a domestic house near a good school is worth more as a commodity in the marketplace than it would be if it was a bit further away. However, when you also consider the "space of representation" that the house provides, including the architectural language of the building, or its decoration and coding, then it enters a relational space. Equally, when the same house is considered as internalising local history, personal memories, local economies, transport links, energy, waste and material flows, and so on, in can only be thought of as a relational condition. Hence, to view a building as a lone object is only to think of it in absolute terms. Alternatively, to view the object as partaking in a series of relationships external to the object is to define it relativistically. Both are legitimate, useful and necessary for certain purposes. However, the richest – and most coherent – conception of architecture is when it is conceived as a complex process, in which the relations, which had been considered external to it in the relativistic framework, are now considered as internal to it, as part of the definition of this particular process-object: this then becomes a dialectical and relational definition. Again, there is a choice as to which relations we might opt to include as internal to the definition (physical, economic, ecological etc). Ultimately, of course, the entire universe – both now and through all time, past and future – has *some* kind of relation to any object in question, and *could* potentially be included. But it would clearly be futile in most cases to do so. Hence the process of definition of the internal relations of

architecture is a process of abstraction which is dependent upon *political choice*s, and is thus a *situated knowledge*.

So, what do we need to do to understand and discuss architecture in these terms? Firstly, we need to oppose narrow market-driven definitions of architectural practice circumscribed by normative capitalist development, and replace these with more holistic social definitions of architecture as a fundamentally ecological or cybernetic practice and discipline. In this sense, architecture might be thought of as:

- the built stuff that surrounds us
- constantly emitting messages
- shaping and creating social, material and energy flows
- morphology, pattern, and demographics
- a Batesonian "ecology of mind", constructed out of organised objects, media, signs, technology and people in space
- a cultural artefact that works as a series of systems embedded within other systems
- grounded in the experiencing body of the human subject
- a form of social prosthesis which extends the human mind and body out into the world, through processes of projection/empathy (Lipps, Schmarsow, Vischer), alienation (Hegel, Marx), technology/media (Marx, McLuhan), networks (Castells)

In the coming chapters I will therefore explore ways of conceiving – thinking about, through and around – the subject of architecture, in all of the ways listed above. It is not, I suggest, a question of whether architecture and design can be ecological; they always already are fundamentally ecological, as defined as "the relations of living organisms to their surroundings."[52] Architecture and design are always as much to do with process and feedback as they are sole objects of production. The question, rather, is in what ways are contemporary architecture and design processes performing ecologically, democratically and socially, and how consciously and openly do they contribute to and make visible and graspable, other bigger planetary and social systems. Beyond that, how can architectural

knowledge not simply focus its concerns on the building as an object-commodity, but start to define its knowledge as a social exploration of the unfolding relationships between humans and their environments?

More specifically and importantly in the current situation, is the question of how can we use architecture and design to *problematise* and *politicise* the existing discourse around the “environmental question”. As McKee has argued, “the task of new environmental art would be to unsettle the self evidence of ‘environment’ itself, addressing it as a contingent assemblage of biological, technological, economic and governmental concerns whose boundaries and agencies are perpetually exposed to conflict.”[53]

1.6 The Plan of this Work

I will, throughout this thesis, refer back to these dialectical frameworks that Harvey and Ollman have set out. In particular, in my discussions about ecology, cybernetics and systems theory, my endeavour is to be attentive to different kinds of spatiality which have been developed by, or are implicated within, a range of different cybernetic and systems processes. Specifically, I will often argue that these discourses have lacked an explicit theory of space and time (although I think that Gregory Bateson went some way to dealing with this), and that many of the paradoxes that characterise contemporary discussions concerning “strong emergence”, “extended mind” and even “morphic fields” take on a new form when theorised in this way. As will hopefully become apparent, such a project is of more than academic importance – insofar as, in the words of Harvey, “our whole understanding of the socio-ecological dialectic, as well as our understanding of place, is directly implicated in how we formulate our understandings of space and time.”[54]

This thesis therefore discusses networks, processes, systems and flows as they operate in, and produce, space and time. I consider these systems as both as objects of study in themselves, and also as modes of enquiry. That is to say, I will explore various examples of architectural, urban and material processes and objects, but I also will use the models provided by systems theories of various kinds as the means of analysis (even whilst attempting to subject those same theories to ideological critique). Through the various chapters I will engage with a different historical moments of systems thinking,

ranging from the subatomic to the mental to the planetary. If at times the project appears to focus on disciplines outside of architecture, that is no more than an attempt to express the very relationality of architecture: i.e. what it is that architecture depends upon. At each scale, I will argue that systems thinking is fundamental to our understanding of the material world, even whilst acknowledging that a particular mode of systemic practice – such as capitalism – defines limits as to how we can conceive of the material world. Architecture *is* the mediation of a series of extensions of the individual human organism, thereby *relating* us to all kinds of social, informational, material and energy flows.

A dialectical approach is crucial to the practice of seeing how many of the *processes* and *systems* which are under discussion constitute, in complex ways, something approaching independent subjectivities – or better, agencies – even whilst they constantly extend and transform our specifically (post-) human subjectivity. The processes that organise and pattern matter and life, the processes of natural environmental flows, the economic and ecological processes of human socio-natural metabolisms, including the historical “permanences” which arise within these flows such as cities, regions, buildings, and of course the particular processes and flows which constitute the human organism – all of these systems can only ultimately be understood in their *relationship* with other processes. We cannot make any sense out of historical and contemporary forms of human consciousness without understanding our extended minds, that is to say, the broader collective ecology of minds, within which we loop. We cannot understand our social formations without understanding our metabolic relationship with other natural systems.

The organisation of the chapters in this thesis can thus be understood, in general, through Ollman’s aforementioned description and analysis of Marx’s dialectical method for seeing the future in the present, for seeing how “communism lies concealed within capitalism.”[55] Ollman abstracts out of Marx’s writings a four-stage dialectical process. In the first stage, Marx looked for the relationships between the main features of contemporary capitalism. Understood as a relational network, the second stage was then to trace these processes back into the past, to find their necessary preconditions. In the third stage, these processes, abstracted as contradictions, were projected from the past through the present, and into a future “sublation”. The final stage in this reading of Marx’s

method, is to look back again from a position in a future scenario to the present (and back through the present to its real past), in order to trace the preconditions of such a future that can be found in the present, in order to use them to develop a political strategy. This final step can then be used as the first step in a new cycle of analysis, and so on.

The deployment of systems theory in architecture, and the concomitant development of architecture as a systems theory, has taken a very distinctive turn in recent years. This has been in response to the very real demands placed upon the discipline by the various imperatives, demands and dilemmas that I will broadly refer to as “the environmental question.” In the following two chapters I will work through a critical history of a series of terms which, I argue, underlie all contemporary approaches to thinking about our condition: nature, organicism, technology, ecology and cybernetics. These terms form a network of conceptual relationships, and have all kinds of histories and ideologies attached. As T.J. Demos has noted, there is today a need to “denaturalise the rhetoric of ‘sustainability’, recognising these buzzwords as deeply political, contentious and ideological.”[56] I will therefore trace a number of these histories, and note their historical moments of interaction with architectural discourse. In several chapters, moments from the cycle of dialectic analysis outlined above are examined with a narrower focus, including the chapters on spatial empathy and cognitive mapping, or on the extended mind.

In particular, my aim is to show that there are a series of concepts which have developed out of cybernetics and its legacy disciplines in recent decades, many of which present opportunities to open up architectural practice in ways that have yet to be fully appreciated. I suggest that many of these concepts can usefully be used in defining the conditions of an extended concept of internal relations in architecture (for example autopoiesis, operational closure, structural coupling, and co-evolution). Furthermore, some of these ideas can help us to reflect upon dialectical materialism’s own history, and in particular to discuss the concept of nature in Marx’s thinking. Drawing together insights from Maturana and Varela, Luhmann and Marx himself, I will re-affirm the intellectual legitimacy of dialectical modes of naturalist-realist thought – albeit in subtly different forms, depending upon where they are deployed in relation to what Felix Guattari has termed (following Gregory Bateson) the three ecologies: personal, social, and planetary.[57]

I ultimately suggest that capitalism might be described, in a combination of dialectical and second order cybernetic terms, as an autopoietic system which displays degrees of operational closure, and which falsely appears from the inside to be a total system, even though it is structurally coupled to, and co-evolving with, any number of external "natural" (i.e. non-human) systems, which lie outside of it.

In the last decade there has been a shift in our understanding of the scale and profundity of the environmental crisis that capitalism has initiated. I will suggest that this has shifted our very relationship to the future, and for certain definitions of modern architecture, which – like modern culture more broadly – are oriented towards the future, this could present a major disciplinary and ideological crisis. In the final chapter, I turn to review the problems of the natural environment at the largest scale, and consider what Marx described as the "metabolic rift" between the forms of capitalism and planetary ecologies. There I will explore a series of systems-based design approaches that might provide the basis for a new political theory of ecology in architecture based upon an expanded view of its internal relations. Ultimately, I suggest that the environmental question in architecture (and more broadly) must be framed in such a way as to construct relations between economy and ecology, mind and matter.

By bringing together these very different forms of knowledge, from architecture to natural sciences, philosophy and aesthetics, this thesis constitutes a fundamentally interdisciplinary body of work. Architecture is of course no stranger to interdisciplinary work – the building and the city are after all interdisciplinary productions *par excellence.* Nonetheless, as noted elsewhere, there are potentially profound methodological problems associated with any such project.[58] To some extent, this thesis attempts to overcome such limitations by also reflecting upon its own process as a piece of design research. As well as referring to all kinds of built material, I also include elements of design research that I have been involved in, ranging from practice to teaching. However, it is not simply in that sense that this thesis constitutes design research. It is, rather, because it follows the method, as described in the quote by Roy Ascott at the start of this thesis, of a fundamentally open-ended design research project. Design research provides us with a unique conceptual framework and intellectual context within which material from different

disciplines (not simply discrete pieces of “design”) with their own different histories can be brought together, and then recombined and placed into new and open-ended relations.

Although the chapters are organised here as one linear sequence, there is a necessary circularity to the material, many cross references between the chapters, and a deliberate layering of the material. Design research and other supporting examples are inserted in floating boxes around the main text, whilst an extensive use of footnotes often creates yet another narrative flowing from the main sequence. The intention is to create a highly discursive text that works in effect as a “bootstrapping network”, in the sense of group theory. For Fritjof Capra, the act of adopting the bootstrap method of the quantum physicist Geoffrey Chew (in whose laboratory he worked for several years) as a technique of bringing together thinking from different disciplines in his own research, allowed him to draw:

> ... large non-linear conceptual maps to make sure that all the concepts were hanging together consistently ... I had learned from Chew that one can use different models to describe different aspects of reality without regarding any one of them as fundamental, and that several interlocking models can form a coherent theory.[59]

Furthermore, in order to facilitate a reading of a series of interacting feedback systems ranging from elementary particles to built environments to biospheres, I have throughout the text tried to describe a consistent set of simple self-similar ecologies. These ecologies help to explain, in a unified way – as metabolisms – the range of diverse material and methods which make up the overall study, and through which:

> ... space time this takes on, potentially, a fivefold character as: (a) a reference grid, (b) a measure, (c) a set of prima facie mutual exclusion relations, (d) a potentially emergent property, perhaps with causal powers of its own, and (e) a generally entropic process.[60]

This thesis, then, is both about systems and processes *in the world*, human and natural, and about systemic *modes of thought* – of which architecture is one – which then allow us to perceive, produce and act in such a world. By outlining a broad survey of systems and process-based based theories, my intention is to define a series of concepts

that can be used to rethink the nature of our systemic production of space. By making visible the complex processes and systems within which we are immersed, architecture can create a space for their social and spatial re-imagining. The underlying argument of this study is that a more sensitive and ecological reconfiguration of the systems of capitalism can only occur when those systems are more visible, and we have adjusted our processes of thinking and designing to take account of them. What I am proposing, then, is a political theory of architecture and ecology.

2 Organon and the Production of Nature

2.1 The Ideological Language of Sustainability

In the previous chapter I rehearsed the need for an ideological critique of the rhetoric around sustainability as it pertains to the built environment under contemporary conditions of global capitalist development. In architecture, increasingly, this critique must consider not only sustainability but also its points of convergence with the rhetoric of “systems”, “ecology”, “networks”, “parametrics”, and “emergence”. This study is not meant as an exercise that will end by revealing in some simplistic way the inadequacies of the current theorising of these terms in architecture (although it may at times facilitate that). It is argued, rather, that an unpacking of these terms and their relations is a necessary precondition for any productive reworking of them. The intention is to open up new areas of critical design engagement, not to reprimand existing ones.

We also need to critique the various histories of systems thinking in order to reveal the ideological distortions that the different forms of knowledge embody, even whilst there is a practical and political need for ecological systems thinking in its varied forms to engage with design education, architectural theory and new forms of practice to an extent not previously considered. Furthermore, within architectural humanities research there is the potential to reformulate the very project of architectural history – in line with David Harvey’s call for a historical geographical materialism – by for example developing case studies of buildings and cities as historical-geographical systems and flows.[1]

In this chapter the aim is to work through a critical history of three terms: “nature”, “organic”, and “ecology”. The next chapter is then focused on cybernetic theory – in particular that of Gregory Bateson – and explores the relation of some of these cybernetic ideas and concepts to various conceptions of “extended mind”. In the terms of Ollman’s dialectical method these two chapters constitute something like a relational network of “keywords” and their histories, which between them define some of the main questions and contradictions facing contemporary architecture and design.

Architecture and the Relation to Nature

The way that the built environment gives form to the metabolic relation to nature of a given society is complex. There are often tendencies that can be found within urban relations to nature that seems to prefigure socio-economic relations to nature. So, for example, the early-medieval walled city anticipates the early-capitalist opposition nature/culture, whilst the late medieval Versaille prefigures the late-capitalist network condition.

Fig. 2.1 Carcassonne. The walled city state, which characteristically emerged in the medieval and early-capitalist period, clearly encultures the social experience of a nature/culture opposition. The walled city state is very reminiscent of a cell or organism, with a membrane that manages its interface to its environment. The origins of the nature/culture dualism that would come to characterise a modern capitalistic relation to nature can be found here.

Fig. 2.2 The Palace of Versailles. Although not ‘simply’ medieval, the extended body of the Sun King is clearly conceptualises a networked Chain of Being, and is not in any simple way an oppositional relationship (as the Sun King sees himself as a natural god).

2.2 The Relation to Nature

> Technology reveals the active relation of man to nature.
> [Karl Marx]

Adrian Forty has argued that "for most of the last five hundred years 'nature' has been the main, if not *the* principle category for organising thought about what architecture is or might be."[2] This is perhaps no surprise, since throughout this period, and as one of its core activities, architecture has mediated the extended metabolic interface – social, spatial, economic and symbolic – between the external world and the human world. The concept (or shifting historical imaginary) of nature has played an important conceptual and ideological role in how we think about our metabolic relationship with the rest of the world, and it is certainly the case that our conception of nature has provided a complex source for a series of metaphors and ideas, whilst of course the stuff of nature provided sites and building materials, in architecture and beyond. In order to approach this complex term, as David Pepper notes, we "need to set the changing attitudes to nature within the context of what people were actually doing to it."[3]

Nature is, in its most common-sense formulation, the "organic", non-human world. It is thus the opposite of man-made culture. Without too much reflection, though, it is clear that the situation is rather more complex than that. It is a commonplace in architectural design juries to hear a critic point out to any student who mentions "nature" – especially if they use a word like "picturesque" – that, "*of course, nature is an entirely cultural construct.*" Such observations are correct, but only up to a point.[4]

In *Keywords*, Raymond Williams suggests that nature "is perhaps the most complex word in the language."[5] He suggests that there are three primary meanings of nature. Firstly, there is the sense of nature as the essential quality of something. The second sense is as a "force" that directs the external world, humans or both. The third meaning of nature is simply the material world. I would suggest that the third category actually breaks down into two distinct though interrelated sets. Firstly, nature can specifically refer to that part of the planet that is alive – that is, the *organic part of the whole*. Secondly, it can refer to the entire material universe, space and time, etc (although

as we shall see, for some systems thinkers, such as the quantum physicist David Bohm, the entire material universe, space and time included, are themselves organic).

Williams argues that the concept starts as meaning the essential nature of something, but becomes abstracted as “the nature of all things having become singular nature or Nature.”[6] That is to say, the fact that everything has its own essential quality is a shared characteristic: i.e. the second meaning. This too becomes further abstracted, Williams argues, into standing in for “everything”.[7]

One might imagine that the natural sciences would have a definition for their subject “nature”. However, as Neil Smith has observed, these disciplines have often avoided any self-reflexive conception of nature, as “the positivist tradition dominates orthodox science, and positivism presupposes (among other things) that nature exists in and for itself, external to human activity. Thus we can know nature only by perceiving its facts and eventually discovering its laws.”[8] Today, Kate Soper argues, nature “has come to occupy a central place on the political agenda as a result of ecological crisis, where it figures as a general concept through which we are asked to rethink our current use of resources, our relations to other forms of life, and our place within, and responsibilities towards the eco-system”.[9]

Neil Smith also notes that “the social concept of nature has accumulated numerous layers of meaning in the course of history.”[10] Its “extremely complex and often contradictory” aspects include, he suggests: material/spiritual, given/made, order/disorder, sublime/secular, dominated/victorious, whole/parts, woman/object, organism/machine, and god/evolution.[11] Nonetheless, Smith argues that all of these meanings are ultimately organised into a dualism which dominates our conception of nature: external/ universal. Smith suggests that one of the effects of this dualism is to make capitalism seem natural, and make capitalism’s exploitation of nature seem inevitable:

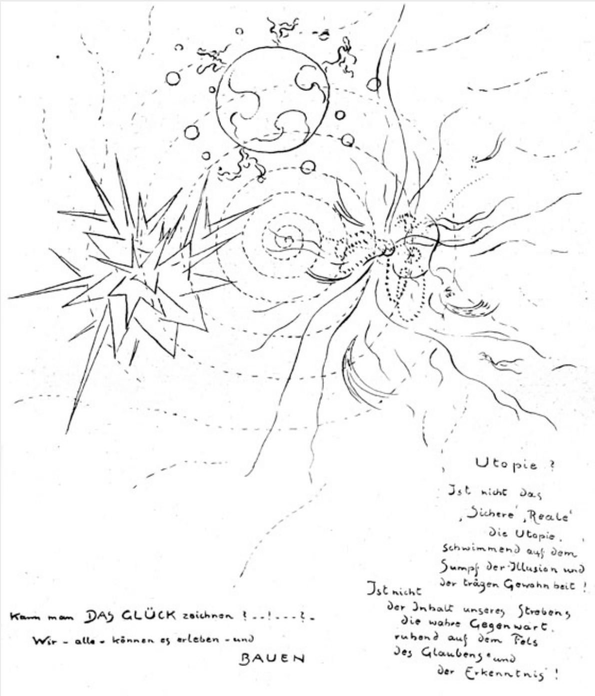
> Sundered apart, nature and society die in reciprocal conceptual torpor … [whilst] the positing of an external nature rationalises and justifies the unprecedented exploitation of nature ... [which is] the “massive racket” that capitalism, historically and geographically, represents.[12]

Architecture and the Relation to Nature

The modern conception of our relation to nature is struggling towards expressing the ecological and systemic:

Fig. 2.3 The Blur by Diller and Scofidio, in Lake Neuchatel in Switzerland, at the 2002 Swiss Expo.

Fig. 2.4 Rachel Armstrong protocell as a part of the Philip Beasley installation *Hylozoic Ground* at the Venice Architecture Biennale 2010.
Fig. 2.5 Bruno Taut, scene from ‘Dissolution Away of the Cities’ (*Auflösung die Städte*)



External nature is the entire domain of the non-human, “it is the raw material from which society is built, the frontier which industrial capitalism continually pushes back.”[13] Universal nature, however, is literally universal – it is everything, including the human world. As Smith notes, this dualism does not always take the form of an opposition; instead external and universal conceptions of nature are often confused.

Within Smith’s dualist definition of nature, culture is what we might call the suppressed internalised relation (the difference between universal and external). Forty has argued that:

> ... the distinction between the world created by man – “culture” – and the world in which man exists – “nature” – has been perhaps the single most important mental category ever conceived, and there can be few disciplines in whose formation it has not been fundamental.[14]

The question is, how fundamental is this mental category? Is it effectively a necessary part of all human thinking, and/or does it take on specific historical and cultural forms?[15] Whilst as we shall see in cybernetic theory, the full unfolding of this question is necessarily recursive and paradoxical, as Harvey notes in his reading of the role of nature in Marx, we are facing a specific historical and ideological form of it.[16] He reminds us that

> ... we have to be careful *not* to read ... through bourgeois categories. Bourgeois categories effectively separate: historically that has been between man and nature, nature and society, nature and culture, natural and artificial, *but that is a bourgeois conception*. [17]

There is something interesting that happens when we think about the question “is the human world a part of nature?”, alongside the question within Marxian studies of whether the dialectical method is applicable in some way to both “natural science” and “social science”.[18] Those thinkers who tend to have developed the most dialectical conceptions of nature (both external and universal) also tend to operate from a basis that makes them very aware of human social metabolic relationships within a broader “web of life”. Furthermore they see dialectical method as indispensable for grasping the (living) nature and form of this human-nature metabolic interface. They also tend to regard the non-human universe of space-time, matter-energy and so on, as being susceptible to

relational and dialectical human reasoning (I would include Harvey and Smith in this category).[19] Such a position is distinct from what is without doubt a more widespread tendency to take the distinction between culture and nature as absolute in practice (if not always in theory). This broad resistance to the possibility of understand nature (however defined) through dialectical analysis is, it seems to me, wholly untenable, and Marx himself directly addresses this question in his so-called *Economic and Philosophical Manuscripts*:

> The universality of man manifests itself in practice in that universality which makes the whole of nature his inorganic body,
>
> (1) as a direct means of life and
>
> (2) as the matter, the object, and the tool of his life activity.
>
> Nature is man's inorganic body – that is to say, nature insofar as it is not the human body. Man lives from nature – i.e., nature is his body – and he must maintain a continuing dialogue with it if he is not to die. To say that man's physical and mental life is linked to nature simply means that nature is linked to itself, for man is a part of nature.[20]

Labour is for Marx ultimately the term that reveals the conceptual unity of nature and culture (I will return to this role of labour at several points again). This unity is perceived as an opposition, and indeed is in real ways constituted as an opposition – or what Marx describes as a "metabolic rift."[21] That is to say, one of the ways that the fundamental contradictions of capitalist production are ultimately played out is precisely in its destructive relationship to a perceived external (rather than universal) environment. Although there has been a consistent strand of modernist art and architecture which has engaged with a more ecological and cybernetic conceptions of the nature/culture dialectic, on the whole this tendency has been marginal. Indeed one of the most problematic aspects of modernism in architecture and in modern culture more broadly, is the extent to which it has facilitated an ideological (and indeed real) construction of a nature/culture opposition. As Harvey repeatedly emphasises:

> ... one of the big problems that has arisen in the bourgeois era has been precisely the way in which *conceptually*, and also *through practices*, and *social institutions*,

Extended Phenotypes, Metabolic Interfaces and The Production of Nature

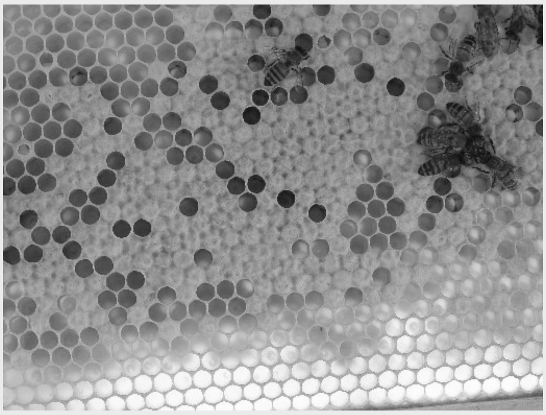
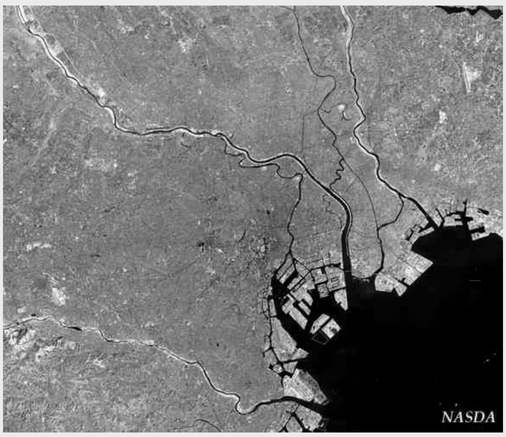


Fig. 2.6 Communal weaverbirds' nests, in Namibia.
Fig. 2.7 Beehives maintain a steady internal temperature, whatever the external conditions

In *The Extended Phenotype*, the neo-Darwinian geneticist Richard Dawkins has argued that environments built by organisms, such as the webs of spiders, the nests of birds, the dams of beavers and so on, might be understood as phenotypic expressions of the genes of the organism, in exactly the same way as fingers, hands and wings are understood to be. Whilst there is certainly something attractive in this concept, as formulated by Dawkins it is problematically reductionist and individualist – and fails to account easily for social constructive activity in animals and insects. A more compelling account can be set out through a Batesonian-Whiteheadian conception of the organism-environment system as the conceptually important unit, rather than the gene: “the boundary of the organism is also the boundary of its environment, and thus its movements can be ascribed to the environment as well... we gain better understanding by describing this boundary and its movements as belonging to both the organism and its environment.” (Alan Watts) Indeed, once we take a systemic view, it is much easier to start to ask questions of human “extended phenotypes” (within the context of a broader production of nature) – questions which Dawkins must necessarily steer clear of. For Dawkins, a termite colony for example is simply another layer of machine, designed to propel genes into the future (like the body of the termite itself). From a systems biology view, once the termite colony system is extant, it makes no more sense to say that than to say the colony is using the genes in each insect to propel itself forward: both are autonomous but structurally coupled. In a related sense we might also grasp something of the metropolis as an semi-autonomous form.

Human extended phenotypes might include both large collective structures like cities, and more basic spatial archetypes, like the megaron, stoa and amphitheatre:

Fig 2.8 Tokyo arial photograph
Fig 2.9 Ancient Greek amphitheatre on Paphos, Greece.



> we have increasingly seen nature as something over there, and society as something over here.[22]

An exposition of the full complexity of the "critical geography" position that Harvey and Smith are developing is not the aim of this commentary. Although they owe a debt to Lefebvre, their work is genuinely novel, not least in that Lefebvre had relatively little to say about nature. That is not the case with Harvey and Smith, who have been particularly clear about what they think the term means. They have notably arrived at a dialectical conception of nature, primarily through the Marxist theory of "uneven development", concerning the way that capital works as a process in space (and in time).[23] Smith captures some of the complex relations that define nature and space:

> ... the problems of nature, of space, and of uneven development are tied together by capital itself. Uneven development is the concrete process and pattern of the production of nature under capitalism.[24]

The question of "the production of nature" is a complex and apparently paradoxical one, and it seems many thinkers have misunderstood this. It is either rejected as absurd ("how can humans produce nature?") or is taken to mean that the human is distinct in the natural world, in that the human species alone changes nature. This is not however how we should understand the production of nature at all. As Harvey makes clear:

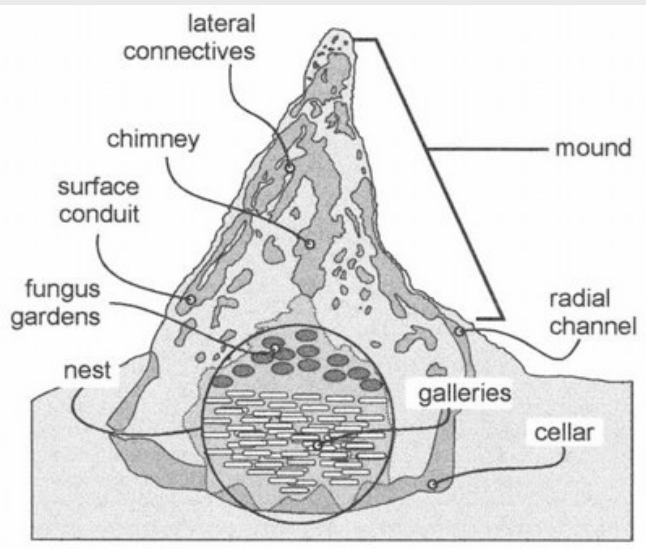
> ... we produce nature; things happen there through what we do, in the same way that things happen there through what beavers do, and what ants do, and what all kinds of organisms do.[25]

Nature then is produced, but it is autopoietically produced, universally, by nature itself. The human metabolic relation is but one network of flows in a much broader web of life. Indeed, it is this conception of the production of nature which distinguishes Marxian ecology from some forms of Deep Ecology,[26] or some ecocentric notions which suggest that the human being uniquely degrades nature. However, most ecological thinkers would agree that it is not straightforwardly obvious how human interventions in natural environment are any different from bees pollinating, etc. It is not the fact of our production of and in nature that distinguishes the human species. Rather, what for Marx – and in a

Extended Phenotypes, Metabolic Interfaces and The Production of Nature

Fig. 2.10 The largest known beaver's dam, built by two beaver families. Over 2800 feet long and extant for at least ten years. Beavers reorganise water flows over large regions, *producing* entire wetland ecologies.

Fig. 2.11 and 2.12. Termite mounds are socio-economic forms, in which generations of termites cultivate fungi-based agricultures. The building activity and socio-economic forms of ants are equally if not more complex, although less obvious as they are network structures within the soil. The largest single ant colony found to date stretches 4000 miles around the north coast of the Mediterranean and across Europe (see http://boingboing.net/2008/12/11/excavation-of-an-ant.html for an extraordinary excavation of an ant city).



different way, for Bateson – distinguishes “the worst of architects from the best of bees”[27] is the extent to which the human has *conscious purpose*.

There is then in no simple sense a “natural” or normal condition of nature. Appeals to “nature” have been used to legitimate all kinds of things, and as Pepper states, “capitalism’s exploitation of nature supported, and was supported by, exploitative attitudes inherent in the scientific world view.”[28] Nature is a process of constant change and transformation as both a cultural concept and as an external reality. For ecosocialists, nature is not the myth of a pure non-human arcadian condition, but is in fact a revolutionary state, *par excellence* – a labouring comrade even! Yet in contemporary culture there is still a strong tendency to suggest that the cultural world is entirely separate from the natural world. Such a position can take many forms, and has been so pervasive for so long that it can today often also be hidden within all kinds of other formulations. It is clearly not the aim of this thesis to exhaustively examine all of the formulations of the nature-culture opposition within architectural history and contemporary practice, let alone in human thought and practice more broadly. However, let us be clear, any absolute attempt to bracket off some conception of the “natural” is always ideological, in that it generally reproduces bourgeois conceptual divisions. It is quite simply impossible to maintain any clear distinction between the natural and the cultural. There is no definitive boundary there, but instead a series of metabolic relationships. For Smith,

> ... when we eventually look back at the intellectual shibboleths of the high capitalist period – say the last three centuries – few ingrained assumptions will look so wrongheaded or so globally destructive as the common sense separation of society and nature. Historically and geographically, most societies have avoided such a stark presumption of hubristic folly, but from physicists to sociologists, physicians to poets, the brains of the ascendent capitalist west not only embraced but made a virtue of society’s separation form nature (and vice versa).[29]

It is interesting to note that in recent years a number of theorists have turned to consider the nature/culture dualism anew. In addition to the Harvey/Smith/Foster/Swyngedouw axis within Marxist social theory today, there was a significant attempt by theorists associated with the *Radical Philosophy* journal (notably Ted Benton, Roy Bhaskar and Kate Soper) in the first decade of its existence (1990s/2000s) to rethink the nature/culture dualism from a

neo-Marxist position. In the coming chapters I will spend some time considering the non-dualist position developed by Gregory Bateson in the 1960s and 1970s from a neo-cybernetic and ecological theory standpoint. However, today undoubtedly the most influential discourse to move beyond a dualistic conceptions of both material and social worlds, both in the way we produce reality, and the human forms of constructing knowledge (humanities/sciences).

In contemporary architectural practice, I would suggest that one of the key *relations* that needs to be explicitly conceptualised, internalised and embodied, is precisely what is the attitude to, and definition of, nature that is brought into the domain of social experience through design practice? In order to approach this question, it is necessary to review how the complex set of relationships between our mental categories of nature and culture are internalised in different ways in a series of terms that nature is frequently articulated through. Perhaps the most important of these is the series of meanings associated with the term "organic". Consider for example this statement by Pepper:

> Marx's ... concept of the society-nature dialectic appears to be, in reality, deeply organic (seeing them both making up one organic body) and monist (physical and mental phenomena can be analysed in terms of a common underlying reality).[30]

It is worth, therefore, scrutinising the term "organic".

2.3 Organic, Organism, Organisation

There is a whole network of concepts and ideas clustered around the root word, *organ*, which includes organic, organism and organisation. Many of these words and concepts have passed through an extraordinary range of ideological uses, which means that for some thinkers today they are perhaps too contaminated to even use. However, not only are they still used heavily today, in often unreflective or ambiguous ways, but they also continue to define important new concepts that do not have any other contemporary description. It is, I suggest, inconceivable that a modern ecological materialism can be elaborated without further new claims made upon the organic, and for this reason a

Organon

Fig. 2.13. The Chain of Being, from Didacus Valades, *Rhetorica Christiana*, 1579. Rocks and minerals are at the base, followed by plants, animals, humans, various angels, etc and finally God.
Fig. 2.14 The Organ of the Duomo di Milano, 1395 (with many additions since). The musical organ seems to capture every sense of *organon*: situated somewhere between a prosthesis and a building, it is difficult to imagine a more interactive architecture. For Rykwert in his essay *Organic and Mechanical* (1992), it was the “quasi-magical” organ designed and built by the seventeenth-century bagpipe virtuoso Michele Todini, which really “combined the attributes of a natural and an artificial object.” Todini’s organ was composed of various wind and string instruments and occupied an entire apartment. Only one of the instruments was actually played, the rest responded sympathetically (or we might say in empathy).
Fig. 2.15. The keyboard and valve interface to the 1929 Atlantic City Convention Hall organ, which with 33,000 pipes is one of the largest in the world.

consideration of the history of the term, and some of the ways that it has been deployed in both general and architectural thought, is required.

Organ originally came to us via Latin, from the Greek *organon*, meaning *tool*, *instrument* or *sense organ*. At the root of the word, then, is a conception of technology, in both the man-made and “naturally grown” sense.[31] According to Raymond Williams, the first use of organ in English was in the thirteenth century, in reference to the musical instrument, and by the fifteenth century it was widely used to describe bodily organs, as in the eye being an *instrument* of sight. In *Keywords*, Williams also notes that although the *organic* and the *technic* came to be conventionally understood as contrasting terms, they started as synonyms, and he quotes a sixteenth-century translation of Plutarch: “to frame instruments and Engines (which are called mechanicall or organicall).”[32] In the eighteenth century it was *organ* in the sense of “instrument or agency” that would come to be the *organiser* of *organisations*. However, by the nineteenth century, Williams notes, the concept of “organic” could be opposed to “organised” in that organic came to imply a natural or similar growth process, whereas simply to be organised implied a human *plan*. It is largely in this sense of organic that Harvey argues that:

> Marx grows his argument organically, it is not building block by building block, or causal bit by causal bit ... it grows .., [I]t is a very distinctive method, partially descriptive of its subject matter ... you don’t understand it as a causality ... you understand it as a unity … Marx says in various places, ‘you have to understand it as an organic system’.”[33]

The definition of the *organism* as a *self-organised* entity is characteristic of the cybernetic and ecological discourses of the twentieth century, but it is to be found in a form remarkably close to the modern sense in Kant’s proto-theory of organism found in *Critique of Judgement*: “we must think of each part as an organ that produces the other parts (so that each produces the other) ... because of this [the organism] will be both an organised and self-organising being.”[34]

2.4 Socio-Political conceptions of the Organic

The idea that the concept “organic” can in some way describe aspects of human society has had a productive life. According to Joseph Rykwert,[35] the first use of organic in this sense is found in the thought of the German scholar Johann Gottfried Herder. As I will discuss in Chapter Six, Herder was also the first person to use the term *Einfühlung* (empathy), which was a key part of his conception of organic.

The term “organic society” has come to be deployed by a wide variety of thinkers on both the left and right. It is however most often used to describe a general pre-capitalist condition, in the sense that the anarchist Murray Bookchin uses it when he claims “the notion that man must dominate nature emerges directly from the domination of man by man … But it was not until organic community relations … dissolved into market relationships that the planet itself was reduced to a resource for exploitation.”[36]

Exactly what is meant by “organic community relations” is always the question to ask. Whilst the metaphor of society as a hierarchical body – with the peasants forming the labouring body, the clergy the heart, and the aristocracy the head – predates the use of the term organic, the two became joined in one of the most important conservative uses of the term organic society, specifically when it was originally used in opposition to revolutionary societies which were seen as “artificial and against the natural order of things.”[37] The hierarchical structure of feudal society was reproduced in an ideological reading of the vernacular cosmology of “natural magic” – through for example certain versions of the Chain of Being – which was then itself reflected back and used to legitimate the “natural organic order” of said society.

This sense of the organic has since come to be widely used to describe the pantheistic, alchemical and natural magic cosmologies that characterised pre-modern European thought in general. Thus Pepper states that:

> ... the organic view permeating mediaeval and Renaissance cosmologies is essentially animistic. If the cosmos is an organism stemming from the immanence of the One – the Absolute Being which is everything – then it is but a small step to have nature and natural objects endowed with the attributes of organisms, especially humans. This was done not merely by giving, for example, ‘brows’,

> ‘shoulders’ and ‘feet’ to mountains, or ‘heads’, ‘gorges’ and ‘mouths’ to rivers, or a circulatory system to the whole earth, it also went on to give each part of nature some soul – some universal spirit which had flowed down into them.[38]

It is this conception of organic which later resurfaced in Romanticism, via Herder, Goethe and the Schlegel brothers.[39] Schelling captured the semi-modern, semi-mystical romantic sense of the term when he stated that:

> Organism is the principle of things. It is not the property of any single object ... [because there] are separate modes of apprehending universal organism – and universal organism is the precondition of the mechanical working of the whole physical world.[40]

Schelling goes on to say – in a paradoxical formulation that, as we shall see, anticipates modern process philosophers and scientists such as Alfred North Whitehead, David Bohm and Ilya Prigogine – that “since this life is the precondition of all things, even those things in nature that seem dead are in fact only extinct of life.”[41]

Pepper notes that ever since Romanticism, modernity has been constantly fed by streams of pre-modern thinking such as “holism, Gaianism and nature worship.”[42] He suggests that although these ideas did not directly constitute the most important roots of modern environmentalism, “they persisted as minor, counter-cultural strands into the nineteenth and early twentieth centuries, and formed the basis of movements and ideas that can be directly traced into modern environmentalism.”[43] It is important to note that such movements are not at all restricted to sentimental and reactionary forms (although as we shall see there are certainly plenty of these), but would notably include early proto-socialist and anarchist groups such as the Diggers and the Ranters,[44] and even arguably nineteenth-century thinkers such as John Ruskin and William Morris.[45] In fact, whilst organicist conceptions were co-opted in support of existing social hierarchies, they lent arguably as much support to radical thought. Organicism “pre-empted notions of dialectics” and “challenged the hierarchical view of the cosmos by emphasising unity, acknowledging that the whole was greater than the sum of the parts, and regarding the parts as of equal value.”[46]

More generally, Pepper notes that the complex mix of ideas present in the early-modern period, and the emergence of modern science out of alchemical experimental practices, were grounded in a natural magic cosmology which conceived of "the universe as an organism, fully alive and active ... permeated with influences, forces and correspondences that linked everything in nature, people included, to everything else, forming a multidimensional network that was not only material, but also mystical and spiritual."[47] The basic "web of life" network structure of such a cosmology has not only persisted in opposition to modernity, but has been repeatedly reproduced throughout modernity. This is most obviously the case in the process-based and systems-based attempts to synthesise a modern holistic science, but is equally present in much more subtle forms, such as for example in contemporary attempts to theorise modern media, financial and informational networks (as I will argue in Chapter Seven). In this regard, the metaphor of the *rhizome* in the work of Giles Deleuze and Felix Guattari has clear if complex relations to this nexus of concepts.

A specifically Marxian formulation of an organic *Gemeinshaft* was developed by György Lukács, for whom "organic" primarily referred to the relationship between "consciousness" in a society and that society's broader formations (production, etc.). Lukács thus states:

> Marxist philosophy of history analyses man as a whole, and contemplates the history of human evolution as a whole ... It strives to unearth the hidden laws governing all human relationships. Thus the object of proletarian humanism is to reconstruct the complete human personality and free it from the distortion and dismemberment to which it has been subjected in class society ... [T]he point in question is the organic, indissoluble connection between man as a private individual and man as a social being, a member of the community.[48]

The use to which Lukács puts this conception to seems to shift over the course of his work, but in general there is a sense that in certain pre-capitalist societies there was an organic relationship between personal, cultural and social forms, and that whilst it is not possible, or even desirable, given the "closed" nature of these earlier relationships, to restore these forms,[49] it is possible to move forward into an "open" modern organic form. As Michael Löwy notes:

Haeckel

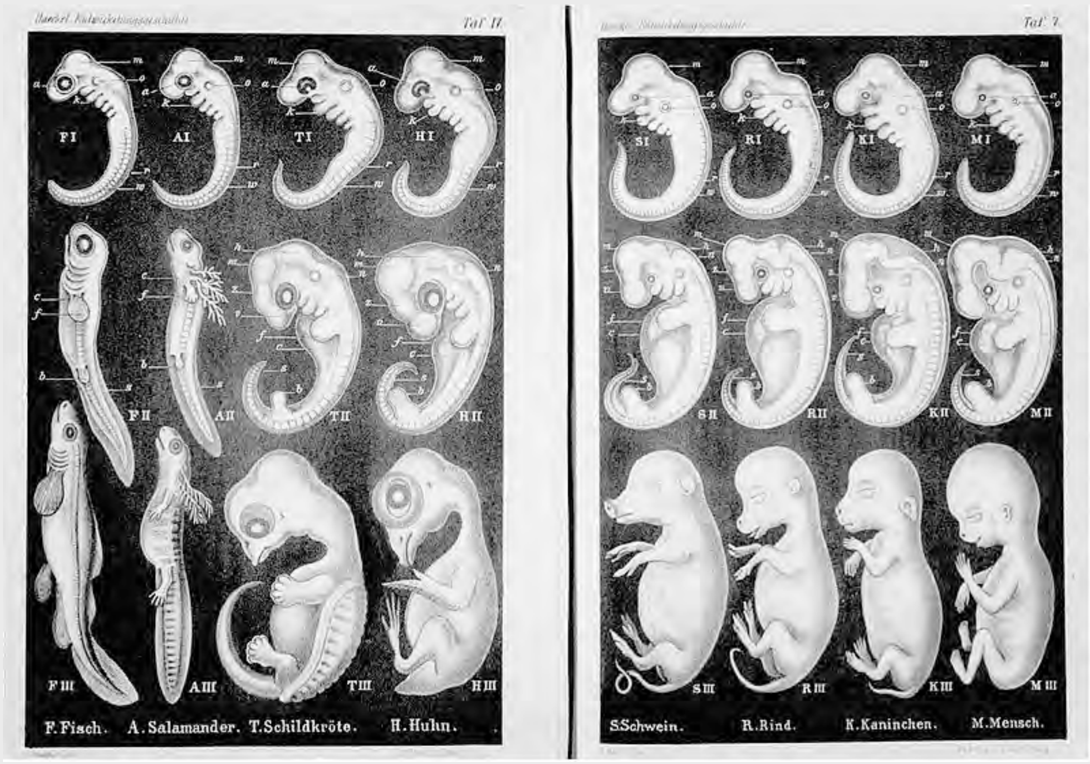
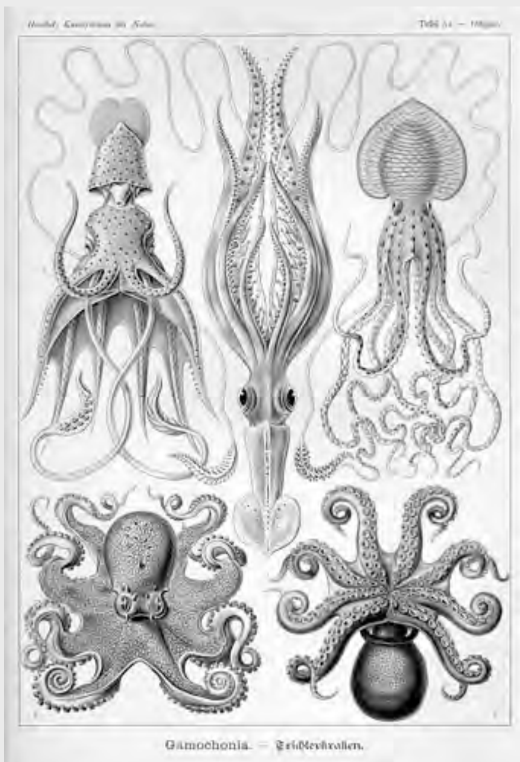


Fig. 2.16. A comparative embryology morphogenesis chart, illustration by Ernst Haeckel from his 1874 book on *Anthropogenie*, who used this to argue for a ‘ontogeny recapitulates phylogeny’ position. This has since been challenged as a theory, as has the scientific validity of this drawing. It is very “rhetorical”.

Fig. 2.17 and 2.18 Nonetheless Haeckel’s images of plants and organisms are extraordinary. Typical botanical and anatomical drawings by Ernst Haecke's 1904 book on *Art Forms in Nature.*



> Lukács perceives socialist revolution as a cultural restoration: organic culture again becomes possible. In a typically romantic-revolutionary way, Lukács understands socialism as the re-establishment of the cultural continuity disrupted by the advance of capitalism; the utopian future (the 'new culture') provides a bridge towards the pre-capitalist past (the 'old culture') above the void of the capitalist present ('nonculture').[50]

Without doubt, both the most innovative and the most problematic and reactionary use of the term organic is to be found in the work of the German biologist Ernst Haeckel. He was one of the most important scientists of the late-nineteenth century, a leading proponent of Charles Darwin's theory in Germany, and is well known still today on account of his extraordinary drawings of plants. Haeckel's position has left a particularly difficult legacy, and is complex to unpick as it draws upon several of the senses of organic outlined above. He coined the term "ecology" in his *Generelle Morphologie* of 1866, which he formulated as the "the science of relations between an organism and the surrounding outer world, to which we can include all its conditions of existence in a wider sense."[51] Haeckel was also an early (holistic-organic) systems thinker in biology, and with Jakob von Uexküll developed the concept of an *environment*.[52] Marx and Engels considered his early scientific work favourably, and Engels refers to him in *Anti-Dühring*[53]

Later in his career, Hackael, like some Darwinists in England, began to adopt Social Darwinian positions.[54] However, whereas Social Darwinism expressed an individualist libertarianism (for example Spencer's "survival of the fittest") in England, Haeckel's took a decidedly nationalist-collectivist turn (needless to say, Marx and Engels position on Haeckel shifted as his nationalist-organic political views, and their increasing effects upon his science, became clear).

Haeckel established the Monist League in 1904, which was initially based upon atheism and republicanism, and even contained leftish factions. However, it became increasingly nationalistic, and developed a right-wing *völkisch* philosophy, combining vernacular holist beliefs with an ideologically distorted science. His "organicist" position took the form of a monism which not only did not see humanity as distinct from nature, but actually denied the validity of the concept of humanity altogether – claiming that it was a internationalising socialist fiction and that actually so-called humanity was a mix of distinct

species (some closer to other animals species), and that these were further determined by their environmental regions into national races.[55] It was the combination of race plus region that defined *the nation as an organism* competing for *Lebensraum*.[56]

Needless to say, Haeckel's version of organicism proved all too useful to fascist ideologues, and this particular political legacy explains the uncomfortable reaction of many contemporary academics to the use of the word.

2.5 Organicism, Wholeness, Process and Systems

The organic as a concept today then, has complex roots. There is an aspect of the concept that makes a direct appeal to a medieval holistic cosmology. This appeal is itself complex: part nostalgic, part reactionary, part radical. To the extent that this notion of a medieval cosmology has any historical accuracy, it can be understood, in the terms defined earlier in this chapter, as a distinct historical relation to, and production of, nature. Such a cosmology also has philosophical roots in medieval readings of the animated cosmology found in Artistotelian philosophy in particular. Equally, it is no doubt in part an imaged cosmology, a constructed projection that is actually as "modern" as the steam engine.

Despite these variously complex and problematic associations, a general conception of the organic prefigured, and indeed contributes to, many of the later insights of modern systems theory. Organicism in this sense is one component of what have been a growing number of relational, systemic or process philosophies that have been articulated over the last century in particular. Whilst these have come out of all kinds of traditions, and have been put to all kinds of intellectual, social and political tasks, it is reasonable to note that organicist and holistic ideas might be understood in opposition to the mechanistic, and as a supplement to the reductivist paradigms that formed the conceptual basis of enlightenment science and technology. Equally importantly, the unfolding of this history is inseparable from the specific historical forms of, relations to, and production of, nature during the growth of the capitalist mode of production.

Whilst it is of course beyond the scope of this chapter to consider all of the ideas that contributed to enlightenment science, it will be useful to understand something of the

mechanistic principle if we are then to grasp the importance of the formation of post-mechanistic organicism.[57]

For Isaac Newton, who formalised the various insights and observations of Copernicus, Kepler and Brahe, in particular, into the basic universal laws of motion (describing things such as planets and apples), the universe was conceived as an absolute and fixed empty space, filled with particles of solid, dead matter. Newton described his conception in the following way:

> It seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable, movable particles, of such sizes and figures, and with such other properties, and in such proportions to space, as most conducted to the end for which he formed them; and that these primitive particles being solids, are incomparably harder than any porous bodies compounded of them; even so very hard, as never to wear or break in pieces; no ordinary power being able to divide what God himself made one in the first creation.[58]

Time passed in this God-created space, which was conceived through the metaphor of a new piece of technology contemporary with Newton's period: the clock. This metaphor provided a compelling overall image of a linear cause and effect world of deterministic mechanical matter – a clockwork universe. It was imagined that if it were possible for one to know at a given moment where all of the atoms of the universe are, and where they are moving, then it would be possible in principle to extrapolate all of the future development of the universe. This conception of the universe as a machine was suggested by the eighteenth-century French astronomer/mathematician Pierre Simon Laplace:

> We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a given instant knew all the forces acting in nature, and the position of all things of which the world consists – supposing the said intellect were vast enough to subject these data to analysis – would embrace in the same formula the motions of the greatest bodies in the universe and those of the slightest atoms; nothing would be uncertain for it, and the future, like the past, would be present to its eyes.[59]

Of course, for Isaac Newton, there was such an intellect – God – which is why Newton famously defined space as the sensorium of God.[60]

There were however problems with this mechanistic model from the start. Plants and animals were considered as automatons: practically lifeless and certainly non-thinking machines, which moved deterministically according to the movement of atoms in their bodies and brains. The human mind presented an even bigger problem for such a conception of the universe. For René Descartes, the result was a dualistic position: a dead clockwork universe of matter, and a separate realm of mind. For Descartes, whose dualism is more accurately understood as a form of interactionism, the human mind and body were joined through the pineal gland in the brain (I will return to consider some of the other legacies of this conception of matter and mind in later chapters).

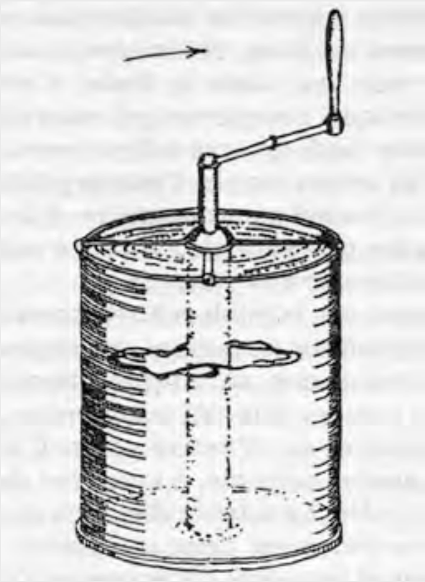
A version of Descartes dualistic model was effectively extended to cover all life forms in the various strands of vitalism in the nineteenth century. For vitalists, it seemed clear that whilst the mechanistic approach might work for inert dead matter, the living organic world could not be explained on the basis of Cartesian clockwork principles. Instead, vitalism essentially extended Descartes' interactionist dualism to cover all of life, by proposing that there is some kind of force or field which animates living matter. Vitalism in this form was first proposed by Hans Driesch, a German embryologist (and former student of Haeckel's, although they were later bitter rivals) who outlined an important modern conception of organicism in his 1929 book, *Science and Philosophy of the Organism.* Driesch experimented on sea urchin eggs by damaging the growing embryos at an early stage through removing cells or splitting embryos. These experiments did not produce the results that might be expected mechanistically, in that the various remains were able to regenerate wholes. For Driesch, these and other experiments showed that some kind of information about wholeness was acting upon the material of the organism, even when not apparently materially a part of it. Driesch explained this as a form of vitalism, which he called *entelechy*, following Aristotle. Yet for Aristotle, entelechy was the process by which form was immanent in matter. For Aristotle form and matter are completed through each other, and *entelechy* was in fact formulated in opposition to the dualism of the Platonic model, which describes a separation between form or idea and matter. Indeed, whilst there are some formulations of vitalism (such as Bergson's concept of "*elan vital*"[61]), which are dualistic, vitalism can also represent a partial overcoming of dualism.

The often controversial biologist Rupert Sheldrake has argued (I think in this instance correctly) that many of the concepts of neo-Darwinist biologists, such as the selfish gene and the genetic programme as the store of all knowledge regarding the organism, are in fact just new forms of vitalism. He states that "the central paradigm of modern biology has in effect become a kind of genetic vitalism."[62] Indeed, Sheldrake argues that the mechanistic model proved *so* insufficient for the life sciences that there is no form of modern materialism that has not ended up needing to be supplemented by some form of disguised vitalism. Paradoxically, though, for Capra, the concept of morphogenetic fields that was developed by Sheldrake is itself just "a sophisticated form of vitalism."[63]

Vitalist dualism in its various forms also speculated about the additional ingredients that might explain life. However, the most radical concept to emerge from – and transcend – vitalistic thinking, organismic or systems biology, argued that rather than some *elan vital* that needed to be added to matter to bring it alive, "the additional ingredient is the understanding of '*organisation*', or '*organising relations*'."[64]

Understanding organising relations was key to the move beyond vitalism and towards the concept of emergence (to which I will return in Chapter Five), which had been suggested via dialectics by Engels in the late-nineteenth century, and was further elaborated by C.D. Broad in the 1920s, when coining the term "emergent properties" in his book, *Emergent Evolution* (1926). Ross Harrison was amongst the first to identify the concept of pattern as a key means of grasping "configuration" and "relationship" as aspects of organisation. His work, and that of the students and researchers around him, explored in particular the formation of morphogenetic fields, through embryological experiments.[65] Lawrence Henderson was an early-twentieth-century biological chemist whose work expanded to consider the shared organisational principles in biology, sociology and cosmology, and who uses the term "system" to describe both biological and social organisations.[66] William Bateson considered how symmetry breaking in morphogenesis related to information. Joseph Woodger's *Biological Principles* (1936) emphasised the importance of "plus organising relations", and noted how life tends to produce hierarchies of nested systems within systems: cells, tissues, organs, organisms, and might be summarised as referring to a "process", "form" or "structure" – often

David Bohm: Wholeness and the Implicate Order: "more like quantum organism than quantum mechanics"



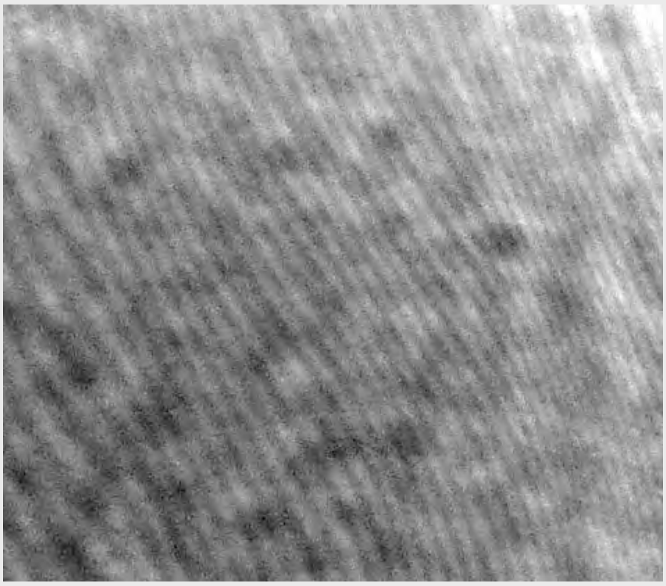


Fig. 2.19 The enfolding of drops of ink into glycerine held between two cylinders. As the cylinders are turned the ink disappears, and appears to be lost. However, if the cylinders are rotated in the opposite direction then the drop of ink will slowly unfold back out as a suspended droplet. If this is done with a series of drops of ink at different times, the ink drop might appear to come pulse in and out of existence along a path. Bohm liked this as an analogical model of implication and explication.

Fig. 2.20 Close up of a holographic plate. Bohm frequently used holograms to discuss dialectical whole/part enfoldment. In a hologram, the whole image is present even in a fragment, although at 'low resolution'.

Bohm proposed a distinct and subtle re-interpretation of the formalism of quantum mechanics, a process based approach which was both more organic and in some sense more realist. Bohm's "Ontological Interpretation" provided an understanding of the nature of many of the paradoxes of the standard interpretation (non-locality, wave/particle duality, indeterminacy) but by effectively re-considering what in the standard interpretation are probability fields as real fields. In the simplest account of Bohm's theory, associated with every particle is a quantum potential, which he describes as an informational field. As Ted Grant and Alan Woods describe it:

> David Bohm was one of the few to provide a worked-out theoretical alternative to the subjectivist 'Copenhagen interpretation' of quantum mechanics. Bohm's analysis, which is clearly influenced by the dialectical method, advocates a radical re-thinking of quantum mechanics and a new way of looking at the relationship between whole and parts.[83]

One of the more startling implications of David Bohm's interpretation, is that it suggests the entire space-time field enfolds in an informational way, a whole global field of pattern that is – *that informs or unfolds with* – local matter. He called this dynamic process the *holomovement*. I discuss some of Bohm's ideas on what he called a rheomode performance of language in regard to ecological aesthetics in the concluding chapter.

In the ultimate Bohmian interpretation, there are a series of underlying fields (which he calls the implicate and super-implicate order), out of which unfolds what he calls the explicate orders, which themselves fold back in.. It suggests that all of the "matter" in the explicate universe is in some important sense in constant processes of non-localised cross communication at other levels of order. This approach represents a distinct form of theorising emergence.

exhibiting growth – in which the parts are networked together to produce a whole (whether a plant or society) which is more than the sum of the parts.[67]

These organic or holistic conceptions of organised whole/part relations represented a radical new stage in the development of modern systems thinking. They emerged first in the life sciences, given that both the mechanistic and reductive paradigms had such clear shortcomings in grasping the totality of living metabolic systems. The processes involved were circular and networked, not linear, and a reductive method that focused upon breaking things into parts, had by definition a limited ability to understand the whole, or the relations between parts.

However, the need for new forms of relational process and holistic thinking would independently arise in the physical sciences too, and were in fact built into both relativity and quantum theories in a variety of ways.[68] In formulating what became known as the standard or Copenhagen interpretation of quantum mechanics, Niels Bohr insisted that it made absolutely no sense to even talk about fundamental elements as independent “objects”. It was necessary to always describe and conceive of the *system as a whole*: the elementary particles could not be understood independently of the apparatus and observer. Thus Bohr would state that “isolated material particles are abstractions, their properties being definable and observable only through their interaction with other systems,”[69] and Henry Stapp later added that “an elementary particle is not an independently existing unanalysable entity. It is, in essence, a set of relationships that reach outwards to other things.”[70] Reviewing the new patterns of matter that emerged from quantum and relativity theory, Fritjof Capra has suggested that:

> ... in modern physics, the image of the universe as a machine has been replaced by that of an interconnected dynamic whole whose parts are essentially interdependent and have to be understood as patterns of a cosmic process. In order to define an object in this interconnected web of relationships, we cut through some of the interconnections – conceptually, as well as physically with our instruments of observation – and in doing so we isolate certain patterns and interpret them as objects.[71]

Contemporary with these emerging insights from the study of biological, quantum and relativistic systems into the organisational patterns of matter and life, the philosopher

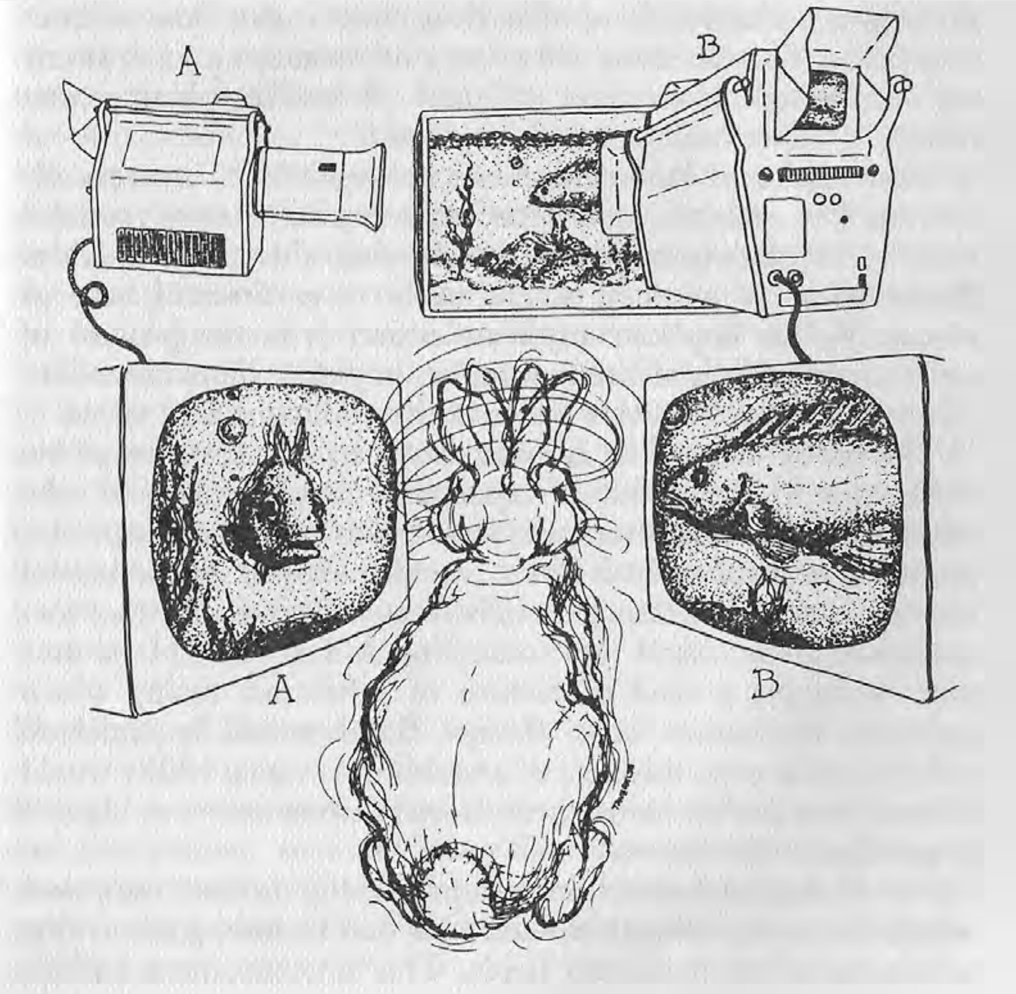
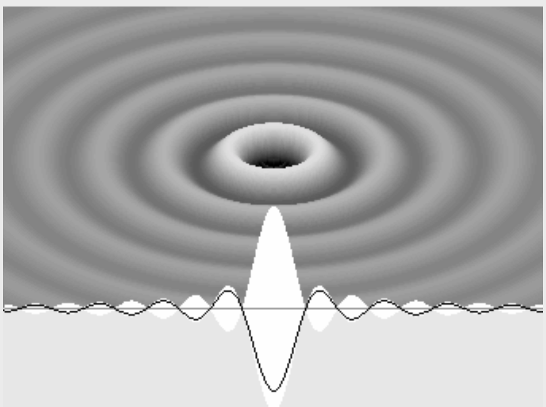
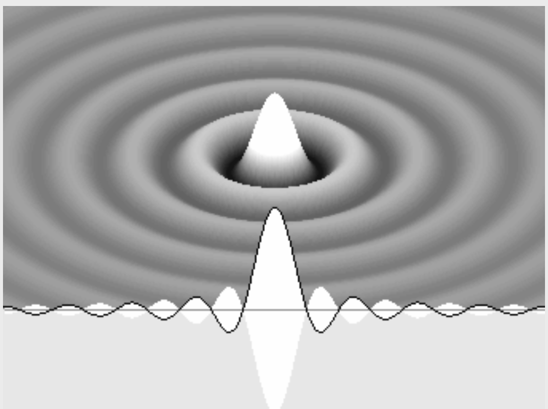


Fig. 2.21 Bohm used the above model of two different elevations of a fishtank as a metaphor for describing non-locality and implicate/explicate relations. The rabbit here sees what appear to be two different though correlated 2D fish, and not the higher dimension He noted that “any form of relative autonomy (and heteronomy) is ultimately limited by holonomy, so that in a broad enough context such forms are seen to be merely aspects, relevated in the holomovement, rather than disjoint and separately existent things in interaction."[84]

Bohm’s practical research work tended to focus on highly organised forms of matter, where quantum coherence effects are evident a classical scales – such as in lasers and super-conductors. Bohm’s collaborators have continued to explore his ideas. Notably, Basil Hiley has recently completed a new mathematical formalism which is currently under peer review prior to publication.

Fig. 2.22 and 2.23 A visualisation of an electron in Standing Wave Theory, which is closely related to Bohm’s description (these are a still taken from an animation). Bohm noted that “the electron itself can never be separated from the whole of space, which is its ground.”[85]





Alfred North Whitehead proposed a process-based philosophy – a quite new metaphysical "concept of nature" and the human relationship to it. Whitehead emphasises what he called the "misplaced concreteness" of matter, and the "fallacy of simple location" of objects. Directly anticipating Bohm's internal relations theory outlined as in *Wholeness and the Implicate Order*,, Whitehead stated that:

> … my theory involves the entire abandonment of the notion that simple location is the primary way in which things are involved in space-time. In a certain sense, everything is everywhere at all times. For every location involves an aspect of itself in every other location. Thus every spatio-temporal standpoint mirrors the world.[72]

Anticipating the potential of modern dynamic systems theories, Whitehead suggested that *organisation* might provide a unified model for both physics and biology. For Whitehead, organisms can be defined as "structures of activity," and for him this process-based definition of organism holds true at all scales, such that he is able to state: "biology is the study of large organisms, whereas physics is the study of small organisms."[73] In fact, as Isabelle Stengers notes, Whitehead consistently defined his entire project as a philosophy of organism, even whilst in his later work, the term itself drops away.[74]

The idea that the most basic organisms of atoms and molecules are in some sense proto-lifeforms is a powerful concept, recalling Schelling's romantic conceptions of living matter. If, as the story is often told, enlightenment rationalism combined with capitalist exploitation and alienation stripped the world of *Geist,* or spirit, then for a series of contemporary thinkers the understanding of systemic organicity announced by Whitehead has provided the opening for another, more modern "re-enchantment" of matter. In fact, with growing momentum through the second half of the twentieth century, a series of new approaches emerged that combined organicist thinking with non-linear mathematics and recursive systems approaches to define an entirely novel process-based conception of "nature". For the most interesting scientists of this period, once again performing as *natural philosophers*, the process thinking of Whitehead offered a particular resonance. As a quantum physicist, David Bohm, drew heavily on Whitehead, and even more so on Hegel, creating an extremely subtle interpretation (a "naturalist" outline of a grand unification theory) that was "more like quantum organism than quantum

Self Organising Patterns of Matter: Far from Equilibrium Systems and the Timing of Space

Fig. 2.24 and 2.25. The Belousov-Zhabotinsky reaction is an autocatalysing reaction (i.e. a feedback system) that oscillates between states, never reaching equilibrium.

Terrence McKenna once described classical linear mechanistic science as the study of phenomena so simple, that whenever experimental conditions were re-initiated, the same thing repeated itself! Such phenomena are in fact, when we look at the world around us, in many ways the exception, and McKenna's description of course does not apply to the self-organising patterns of matter that have characterised the research of Ilya Prigogine and the non-linear and recursive sciences of chaos, complexity and life (and which McKenna, often in collaboration with chaos mathematician Ralph Abraham, spoke so wonderfully about).

Prigogine's work has been characterised by research into the behaviour of material systems (technically "dissipative systems": systems that dissipate entropy into their external environment, whilst increasing order in their internal milieu) in environments that are defined as "far from equilibrium". If an *equilibrium* system is homogenous and stable, and generally closed, a *far-from-equilibrium* system contains dynamic differences: flows of energy and matter. Dissipative systems "live" off of the flows of a far from equilibrium environment. As Maturana and Varela would show, this is necessarily the case for the autopoietic dissipative systems that we call organisms – but as Prigogine demonstrated, this is also true for simpler dissipative systems like whirlpool vortexes (eg. Fig. 2.26). As the cybernetician Norbert Weiner anticipated, "we are but whirlpools in a river of ever-flowing water. We are not stuff that abides, but patterns that perpetuate themselves."[86] For Prigogine and Stengers, these insights:

> ... leads to a new view of matter in which matter is no longer the passive inert substance described in the mechanistic world view, but is associated with spontaneous activity. This change is so profound that ... we can really speak about a new dialogue of man with nature.[87]

mechanics."[75] Like Bohm, Ilya Prigogine has redefined what we understand by *order* and *structure*, or more accurately, the dynamic relational processes of *ordering* and *structuring*, in his work on dissipative and far-from-equilibrium systems that lie at the edge of chaos and life. Prigogine's collaborator, Isabelle Stengers, would go on to become a prominent Whitehead scholar. A series of cybernetic and ecological theorists, notably Gregory Bateson, Erich Jantsch, Humberto Maturana, Francisco Varela and Ricardo Uribe, shared these interests in self-organising systems, which were further developed by Stuart Kauffman and the Santa Fe Institute's research into complexity.

In all of these cases we find something approaching a philosophy of internal relations based on the redefinition of nature and agency. Frequently these scientists and their associates have gone on to propose wide-reaching "metaphysical" syntheses, variously describing "an emerging science of wholeness" (Peat/Briggs), "a new kind of science" (Wolfram), "a new dialogue with (and re-enchantment of) nature" (Prigogine/Stengers) an idea of a humanity that was now part of "a web of life" (Capra) and no longer necessarily existentially alienated, but potentially once again "at home in the universe" (Kauffman). All of these can be loosely characterised as articulating a "hylozoist wonder"[76], or even modern forms of panpsychism (which I will return to in a different sense in Chapter Seven).[77] Whilst it would be a mistake to overstate this point, or to describe as a single unified discourse what remain different conceptions of *material agency* and *self-organising patterns*, it is indisputable that there are significant parallels in all of these accounts which can be argued constitutes the beginning of a paradigm shift. The cultural effects of this new cognitive (if not economic) relation to nature – particularly within ecological philosophy – have been profound.[78]

Emphasising the resonance of modern systems, process and organismic approaches with many vernacular traditions of thought, Sheldrake argues, in terms that in this instance are quite non-controversial, that:

> ... the holistic or organismic philosophy, or the 'systems' approach, is in one sense a new form of animism: nature is once again seen as alive, and all organisms within it contain their own organising principles within themselves. They are no longer thought of as souls, as they are in Aristotelian philosophy, but are given a variety of other names such as "systems properties" or "emergent principles of organisation"

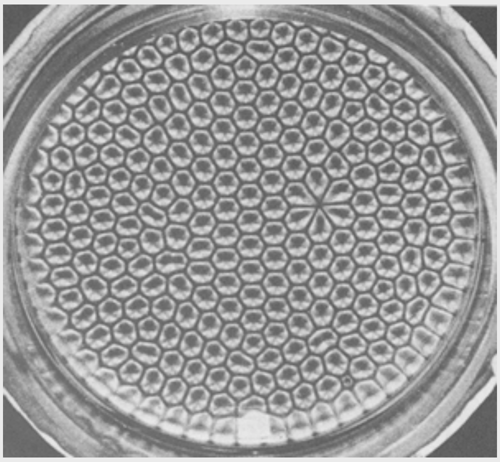
 

Fig. 2.27 Bénard Cell convection currents in a heated liquid – a favourite example of Prigogine – show how a liquid self-organises when a constant flow of heat passes through it (such that the liquid has a metabolism). The liquid will typically pass through a few stable states before solving the problem through hexagonal close packing.
Fig. 2.28 The effects of atmospheric Bénard cells in shaping sand dunes in a desert.

Dissipative systems embody a non-human agency that makes the description of their conditions of emergence-existence, of becoming, fascinatingly difficult in terms of formal human logic and embodied language. The attempt to describe them in terms that emerge from the "entity" in question (or more accurately, in terms of our relations to them, and through them), is one of the tasks that the cybernetic project, broadly conceived, set itself.

In a formulation that suggest that there might be new ways to think about *metabolism* in political ecology as *the timing of space*, Prigogine and Stengers note that in their work:

> ... the analogy with social phenomena is inescapable. Far from opposing 'chance' and 'necessity', we now see both aspects as essential in the description of systems far from equilibrium ... new aspects of time have been uncovered ... probability and irreversibility had to be closely related. Only when a system behaves in a sufficiently random way may the difference between past and future, and therefore irreversibility, enter into its description ... It has often been stated that science spatialises time. But we now discover that another point of view is possible.. we have been led to study the 'timing of space.'[88]

There is a fascinating resonance with Marx's doctoral thesis on the Epicurean philosophy of nature, and in particular the dialectical relationship between chance and necessity that Marx found expressed in the *chance* swerve of the Epicurean atom – a paradoxically *necessary* swerve in that it opened to door to history and time, freedom and creativity for Marx, much as it does for Bohm, Prigogine and Stengers.

> or "patterns that connect" or "organising fields." But the modern philosophy of organicism differs in two fundamental respects from pre-mechanistic animism: first, it is post-mechanistic, and is developing in the light of the insights and discoveries of mechanistic science; and second, it is evolutionary.[79]

Combinations of modern and pre-modern organicisms have thus fed into a wide range of environmental philosophies, including the important relational Deep Ecology philosophy of Arne Naess, for whom "a human being is not a thing in the environment, but a juncture in a relational system without determined boundaries in space and time."[80] Frequently, today, many ecocentric thinkers see in organicism a return to the belief in a Chain of Being – this time, however, ecological – and a basis for a broader animism or more general correspondences with folk and/or oriental cosmologies. This often productive though potentially problematic tension within conceptualisations of the organic – i.e. between a modern scientific holism and a vernacular mystical belief system – is replayed throughout the development of ecology, and within the environmental movement and ecocentric thought more generally.

The conceptual development of "re-enchantment" has not been restricted to ecocentric theory alone, however. David Harvey – in attempting to chart common territory between anti-capitalist green and red political groupings, as well as identify shared intellectual labour between ecocentric process based philosophy and Marxian dialectics – has proposed an interesting and perhaps surprising cross-reading of the Marxist-Hegelian concept of alienation, and subsequent re-enchantment. Harvey states, for example, that "parallel strains of thought, such as 'process-based philosophy' and 'organic' lines of argument advanced by, for example A.N. Whitehead, David Bohm, and a variety of contemporary ecologists such as Arne Naess and Fritjof Capra, bear some sort of relationship to Marx's dialectics."[81] Whilst nonetheless being clear to distinguish between progressive leftish conceptions and the more reactionary moments in some ecocentric thought, he suggests that:

> ... for Marxists, there can be no going back, as many ecologists seem to propose, to an *unmediated* relation to nature (or a world built solely on face to face relations), to a pre-capitalist and communitarian world of non-scientific understandings with limited divisions of labour. The only path is to seek political,

> cultural and intellectual means that ‘go beyond’ the mediations ... while acknowledging the significance of such mediations. The emancipatory potential of modern society, founded on alienation, must continue to be explored. But this cannot be, as it so often is, an end in itself for that is to treat alienation as the end point, the goal. The ecologists’ and the early Marx’s concern to recuperate ‘in higher form’ the alienation from nature (as well as from others) that modern day capitalism instantiates must be a fundamental goal of any ecosocialist project ... The idea of ‘re-enchantment’ with the sensuous world through a more sensitive science, more sensitive social relations and material practices, through meaningful labour processes, provides a better language than that of alienation with all of its essentialist overtones.[82]

It is a fascinating yet problematic objective for ecological thinking. In the next chapter I will therefore continue to explore these parallels between Marxian dialectics, ecology and cybernetics. This then sets the stage for the performance of new political conceptions of ecology, metabolism, cognition and dwelling: or what I term a critical urban ecology.

3 Dialectical Ecology: Towards a Critical Metabolic Materialism

> Organism connotes a knotty dialectic: a living system makes itself into a entity distinct from its environment through a process that brings forth, through that very process, a world proper to the organism.[1]
> [Francisco Varela]

3.1 A Dialectical approach to Organism

David Harvey has noted on several occasions – as seen in the previous chapter – that there is much in the traditions of organic and ecological philosophy which, through its emphasis on process and relational thinking, shares something with Marxian dialectical theory. Thus, he suggests that the latter might:

> ... learn a great deal from trying to understand ecocentric lines of thought ... They help concentrate my mind on the qualitative as well as the quantitative conditions of our metabolic relation to the world and raise important issues about the manner of relating across species and ecological boundaries that have traditionally been left on one side in many Marxist accounts.[2]

Whilst I strongly concur with Harvey regarding the desirability of “trying to understand ecocentric lines of thought“ within a framework of Marxian dialectical relations, in this thesis I am especially interested in other – and often closely associated – traditions of relational thinking that are also worthy of “trying to understand”. In particular, there have been a series of attempts from figures in systems biology to use relational dialectical thinking to redraw our conceptions of the organism, of whole/part relations, and of a series of ideas associated with emergence. In addition, within some of the more critical and radical strains of neo-cybernetics – notably Gregory Bateson, but also others such as Stafford Beer, Francisco Varela and Evan Thompson – we find interesting forms of what can well be described as dialectical thinking.

The biologist Richard Lewontin has argued that a dialectical interpretation of dynamic systems theory can avoid what he argues are the twin spectres haunting systems biology: atomism, at one extreme, and medieval holism, at the other. He suggests that these two tendencies must be reformulated as a thesis-antithesis dialectic.[3]

For Lewontin, dialectical method and relational thinking can help us to *see* and think about the ways that complex systems organise themselves. For example, a dialectical conception of “organism” understands the relationality of parts to each other, and to the whole, but in no sense rejects the possibility of abstracting parts from a whole, or abstractly conceiving the whole as whole. Indeed, it argues that such a process of *abstracting* parts from wholes is essential not just to the possibility of modern scientific thought (including the activity of reconstructing wholes), but is fundamental to the actual processes of life itself. For those thinkers concerned with bringing a dialectical pattern of relational thinking to dynamic systems theory, the kinds of propositions and descriptions that emerge give a more coherent account of the kinds of phenomena categorised as one or other form of emergence.

One particularly powerful definition of the organism has come from the Chilean cybernetic biologists Humberto Maturana and Franscisco Varela (who was a student of Maturana), and later extended by Evan Thompson (who was a student of Varela). Both Varela and Thompson have described their definition of the organism (and by extension of emergent whole/parts relations in general) as being dialectical. Varela takes a working definition of dialectics from Lewontin’s book, *The Dialectical Biologist*, as relational properties where “one thing cannot exist without the other, that one acquires its properties from its relation to the other, that the properties of both evolve as a consequence of their interpenetration.”[4] Thompson too has described his thinking in dialectical terms. Whilst both Varela and Thompson certainly took some conception of dialectical process from Lewontin, who framed his thinking in explicitly Marxian terms, they were equally if not more interested in a different tradition of dialectical theory derived from Merleau-Ponty, and from the European phenomenology tradition more broadly (I will return to this in coming chapters).[5]

Maturana and Varela’s development of a distinct strand of what Gordon Pask referred to as “new cybernetics” had a wide impact far beyond biology. Notably, the German social systems/cybernetics theorist, Nicklas Luhmann, took many of Maturana and Varela’s insights into the operational systems of organisms back into social science. Maturana and Varela’s primary conceptual move was the definition of *autopoiesis*. Simply

On the Shoulders of Giants

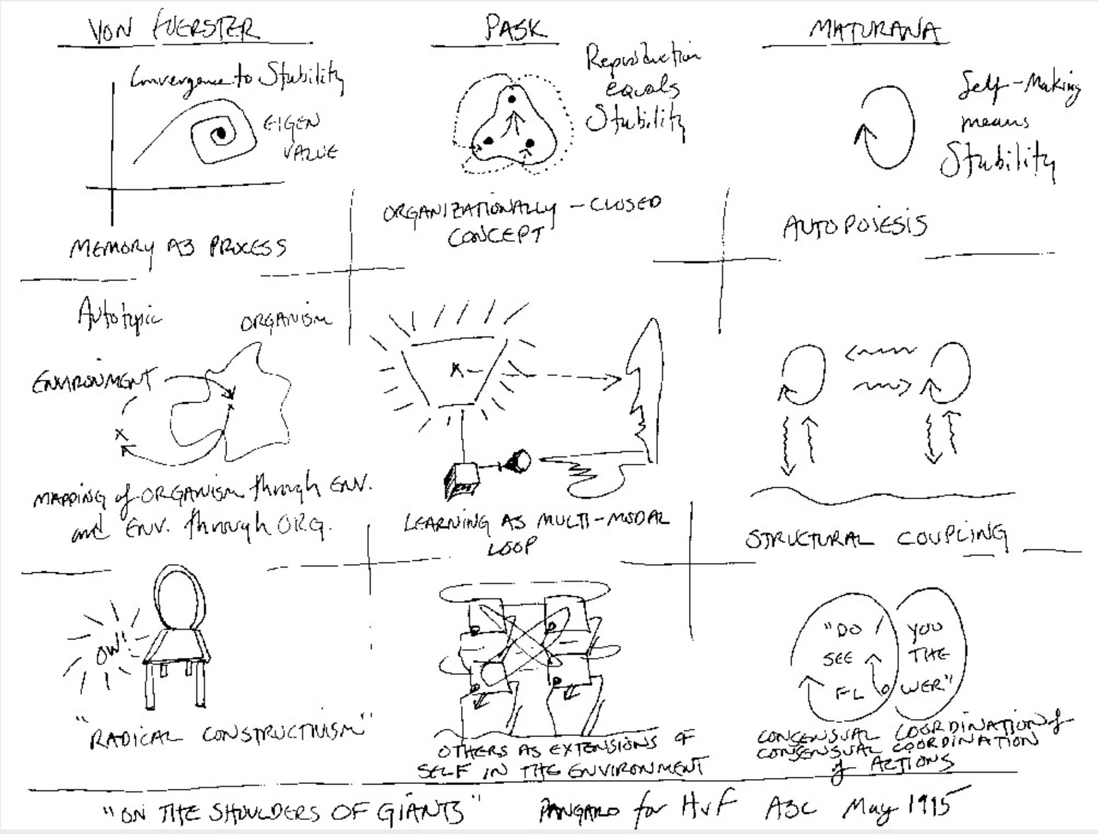


Fig. 3.0. On the Shoulders of Giants, by Paul Pangaro (1995). Pangaro produced this cognitive mapping of some of the key concepts of second-order cybernetics for Heinz von Foerster.

stated, autopoiesis defines an organism that is not just an organised whole composed of parts, but is rather a self-producing and self-organising whole (remembering Kant's prescient definition). An autopoietic unity is autonomous, which is to say, it has a self sustaining internal organisational coherence that projects itself into the future, and which experiences a world that it itself "brings forth" through (and importantly, is limited and defined by) its co-evolutionary interactions and couplings with its environment. An autopietic unity is autonomous then, but also – in a profoundly dialectical manner – its autonomy derives from its very interconnectedness with the external world. We are here at last back to the original conception of *organon*. It contains two moments. Firstly, there is the "simple organism" which is just an organised whole composed of parts. This of course describes all machines and tools so far made by humans. The second conception is of an organism which exhibits autopoiesis: that is to say, a whole which is composed of a feedback network of parts which produce a "membrane" (or "boundary", "enclosure" or "distinction"). This membrane encloses and produces an internal environment within which the networked parts can themselves produce the membrane. In elaborating upon how this system works, Maturana and Varela thus introduced into cybernetics, ecology and system theory a valuable series of terms: autopoiesis,[6] structural coupling,[7] co-evolution,[8] structural and natural drift,[9] and operational closure.[10] What I think is notable in their conception (and which I think Marxian scholarship has not picked up on) is that the organism *is based upon a labour theory of both life and cognition*.

3.2 A Labour Theory of Cognition

For Maturana and Varela, the most fundamental definition of a living organism is that it is autopoietic: a producer, labouring to produce itself. Moreover, they define the metabolic relation between an organism and its environment as being cognitive. What is meant by this? Primarily they argue that any interaction between a unity and its environment is a form of perception – that *practice is just what perception is*: "all doing is knowing, and all knowing is doing".[11] Thus they reminds us that:

> Circularity ... between action and experience, this inseparability between a particular way of being and how the world appears to us, tells us that every act of knowing brings forth a world.[12]

This is true not only of mega-complex mammals like humans, but also of the most basic chemical reactions between the most basic organisms. Describing what they call a “biological phenomenology”, they state that:

> ... if a cell interacts with molecule X and incorporates it in its processes, what takes place as a result of this interaction is determined not by the properties of molecule X but by the way in which the molecule is seen or taken by the cell as it incorporates the molecule in its autopoietic dynamics.[13]

Whilst all living entities occupy the same physical universe, their perceptions of it are entirely different, structured by their particular modes of engagement with it. As Alva Noë, drawing in particular upon the work of Varela and Thompson, puts it:

> ... conscious beings have worlds precisely in the sense that the world shows up for them as laden with value: sugar! light! sex! kin! The mind of the bacterium, such as it is, consists in its form of engagement with and gearing into the world around it. Its mind is its life.[14]

The identification of the relation between autopoiesis, mind and value is of critical importance here in understanding both the most fundamental sense in which mind is embodied and extended – a question which forms the specific focus of the next chapters – but also in returning to consider how to think the human metabolic relation to nature, remembering that I am arguing throughout this study that today one of the key tasks confronting architecture and design is to make visible existing relations, and to image and configure new relations, to and within nature. This is not in opposition to human culture, but as a living culture-nature metabolism, precisely as a non-deluded and non-dualist human experience of bringing forth our world.

For Marx, labour is “a process between man and nature.”[15] He states that labour is not a process that emerged under capitalism, but is actually a universal process – albeit,

of course, one that takes on specific historical and geographic forms. Just a few pages into *Capital*, in its first chapter on “The Commodity” , Marx states:

> ... labour, as the creator of use values, as useful labour, is a condition of human existence which is independent of all forms of society; it is an eternal natural necessity which mediates the metabolism between man and nature, and therefore human life itself.[16]

David Harvey has pointed out that the conception of labour as a universal category is a notable occurrence in Marx’s thinking. Harvey notes that “Marx again and again emphasises that the categories of political economy are the categories generated out of bourgeois practices ... but he makes a singular exception to that rule: labour.”[17] Bearing in mind then this exceptional role that labour plays, we can return to Marx, who continues:

> ... when man engages in production, he can only proceed as nature does herself, i.e. he can only change the form of the materials. Furthermore, even in this work of modification he is constantly helped by natural forces. Labour is therefore not the only source of material wealth, i.e. of the use-values it produces.[18]

This is a crucial passage in Marx for all kinds of reasons. It clearly separates Marx’s labour theory of value from some other classical, and more recent, labour theories of value, in that it recognises that labour is not the sole source of value,[19] and that extra-human “natural forces” also produce value for humans. He then goes on to conclude, “labour is the father of material wealth, the earth its mother.”[20] This gendering of labour is not unfamiliar. Just as matter has the etymological root “mother”, and the earth is frequently referred to as a female goddess or mother, so matter is also paired etymologically with pattern or the paternal. The patterning of matter is then the labouring of it, and the en-minding of it. It is also the en-culturing of matter.

In the seventh chapter of *Capital*, titled “The Labour process and the Valorisation Process”, Marx starts by stating that he will “have to consider the labour-process independently of any specific social formation.”[21] He states that the most basic, “first instinctive forms of labour”[22], are in fact not even uniquely human, but can be found

throughout the natural world. He cites two kinds of examples of this, both of which are of great interest to this general discussion.

Marx starts by giving what I would argue is a thoroughly ecological and cybernetic account of what differentiates “labour in a form in which it is an exclusively human characteristic”[23] from “those first instinctive forms of labour which remain on the animal level.”[24] He states: “the human, through its own actions, mediates, regulates and controls the metabolism between itself and nature.”[25] He goes on, suggesting that this regulation and control is a form of a feedback loop, a dialectic, as the human “confronts the materials of nature as a force of nature ... through this movement he acts upon external nature and changes it, and in this way he simultaneously changes his own nature.”[26]

He goes on to clarify further the distinction between non-human and human forms of labour, and uses as an example a comparison between the kinds of constructions that Richard Dawkins has described as “extended phenotypes”, and buildings produced by human architects. Marx states: “a spider conducts operations which resemble those of the weaver, and a bee would put many a human architect to shame by the construction of its honeycomb cells. But what distinguishes the worst architect from the best of bees is that the architect builds the cell in his mind before he constructs it in wax.”[27] It is having “a purpose he is conscious of” that is the crucial difference here, a difference that Gregory Bateson would identify as the difference between mind and consciousness, and I will return to this at several points in the coming pages. There is much more to be said no doubt concerning the way that all organisms produce nature as they produce themselves, and the way that humans both produce nature, and produce within that what can be described as a “second nature” (to use a term from Lukács). In his review of ecological concepts in Marx and Engels, Howard L. Parsons noted – in a passage that many neo-materialists would do well to reflect upon – that:

> ... the logic of man’s dialectical relation to non-human nature does in fact lead to the conclusion that the ground of values, if not the values themselves, is prior to and independent of man’s conscious intervention in and enjoyment of non-human nature. For in the process of sensing, acting upon, appropriating non-human objects, man secures objects that are not man made but still have use-value, i.e. properties that are value yielding. The dialectical process between human

> organisms and environment which is creative of human value is illustrative of a general pattern of organismic-environmental activity by which species sustain themselves and survive. But the adjustive pattern of organisms is the adjustive pattern of molecules complexly organised. Molecules bond, and atoms unite or do not according to their valences. Value is not an epiphenomenon added to fact; it is an inherent activity of matter. What an apeman does in his social group and with his tools prefigures what Homo Sapiens does, just as the valuing activity of apeman is prefigured in lower primates, in earlier mammals, and in single cell organisms.[28]

3.3 Technological Metabolisms

Much has been made by both David Harvey and John Bellamy Foster of the footnote at the beginning of the fifteenth chapter, “Machinery and Large Scale Industry”, in the first volume of Marx’s *Capital*.[29] Marx starts with the suggestive remark that “a critical history of technology would show how little any … inventions … are the work of a single individual. As yet such a book does not exist.”[30] Foster suggests that in this piece of text Marx returned to the ancient Greek meaning for *organon*, which as discussed meant both tool and organ, and “expressed the idea that organs were essentially the “grown-on” tools of animals.”[31] Marx states that technology as he defines it has two aspects (and these two aspects reproduce the dualism of “nature” discussed earlier). There is natural technology – of “the formation of the organs of plants and animals, which serve as the instruments of production for sustaining their life”[32] – which he credits Darwin for producing a history of.[33] Secondly, there is technology made by human society. He asks “does not the history of the productive organs of man in society, of organs that are the material basis of every particular organisation of society, deserve equal attention?”[34] This is an interesting sentence which opens up all kinds of questions. Although technology has two components, they share a common relation, which is that they both exhibit organic characteristics. In addition, in a passage that anticipates some of the work of neocyberentic social systems theorist Niklas Luhmann, Marx also sets human society into the same relationship *but at a higher level* – “organs that are the material basis of every particular organisation of society “ – and thereby produces a very distinct organic definition of society by suggesting that the organs of technology are themselves the

“basis” for the organisation of society, or that society is *organised* through the *organs* of technology. For Marx, it is not that (as is often imagined) society is organic, and then technology comes along and destroys that, but rather, that human society as society is organic in so far as it is technological.[35]

Technology, then, has two aspects: natural and social. It is a unitary concept, and achieves that through the unity expressed by *organon*. Technology in the universal sense is what we share with nature, but is also our means of engaging metabolically with the rest of nature.[36] Hence, Marx states:

> ... technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from these relations.[37]

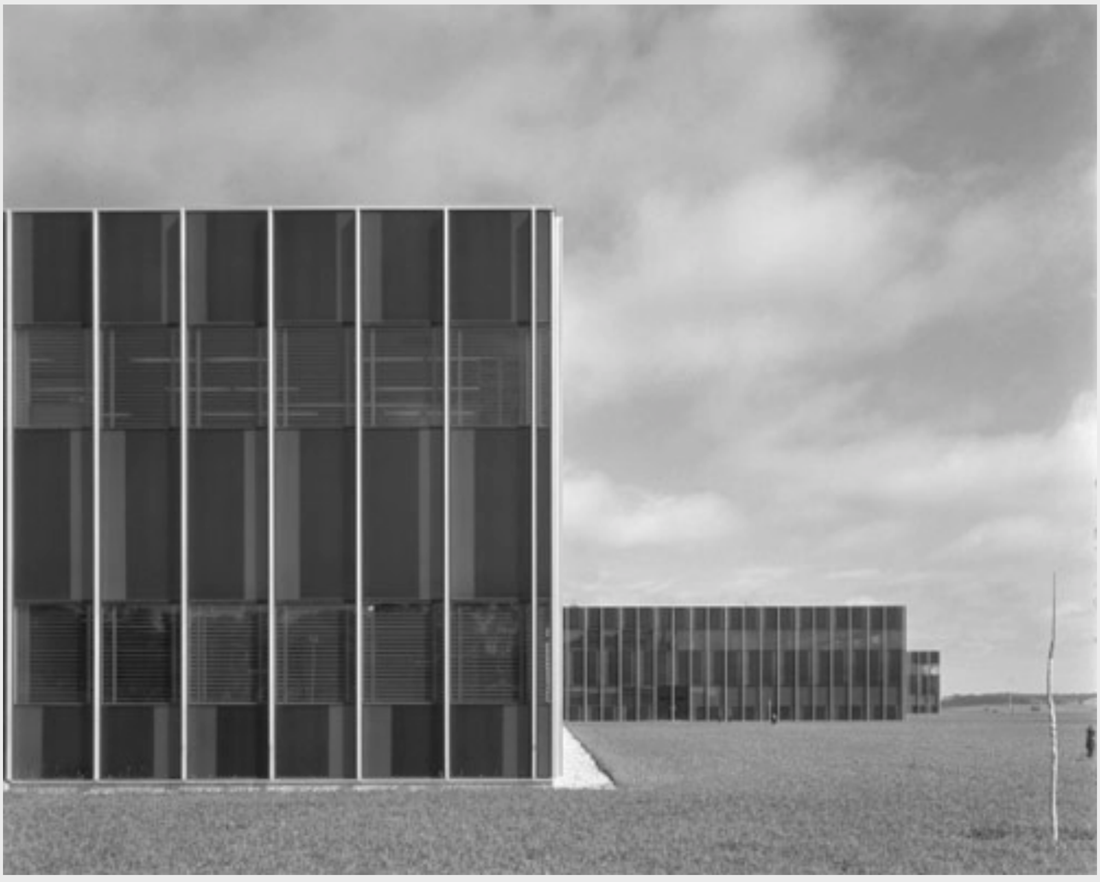
3.4 Organic Architecture and Urbanism

There has of course been an important extension of the use of “organic” specifically within architectural discourse, although it is beyond the reach of this chapter to deal with this in anything but the most cursory review. As has already been mentioned, Frank Lloyd Wright developed a particularly distinctive sense of organic which combined many of the above uses of the term. For Rykwert, Wright’s conception of organic was the first formulation in modern architecture of the concept of *Gesamtkunstwerk.* Wright’s wife, Olgivanna Hinzenberg, was a student of the Russian mystic, G.I. Gurdjieff, and she introduced Wright to his ideas; the two men met at Taliesin, Wisconsin in June 1934.[38]

It is often noted that Einstein exclaimed upon seeing Mendelsohn’s Einstein Tower: “organic!” Rykwert rightly makes much of Mendelsohn’s later reflection upon this statement. In a lecture in 1943 Mendelsohn stated that “I understand what he means: that you can’t change or take away a part without destroying the whole.”[39] In its most common architectural usage, organic tends to be associated with a plant-like form. It is often associated with architects like Antonio Gaudi, and movements like Art Nouveau, or more recently as a description of the biomorphic forms facilitated by digital software. However, it is in the formal and spatial “wholeness” sense used by Mendelsohn that it has had its

Organic Architectures

Fig. 3.1. The “organic” Einstein Tower by Erich Mendelsohn, 1919-21.
Fig. 3.2. Hugo Häring, housing in Siemanstadt, Berlin.
Fig. 3.3. IBM Headquarters, Rochester, Minnesota, Eero Saarinen, 1958. For Reinhold Martin an exemplary piece of organic organisational architecture.



strongest architectural meaning. For Bruno Zevi, in his book *Towards an Organic Architecture* of 1944, it was in this sense, further combined with function and social form, that organic really meant something, and in Zevi's collection of examples one would struggle to find any morphologically plant-like architectural examples. Mies captured well the tasks that this concept of organicism was confronted with during this period. Speaking in 1938, he declared:

> Let us recognise that the mechanistic principle of order overemphasizes the materialistic and functionalistic factors. It fails to satisfy our feeling that means must be subsidiary to ends and our desire for dignity and value. The idealistic principle of order, however, with its overemphasis on the ideal and the formal, satisfies neither our interest in truth and simplicity not our practical sense. So we shall emphasize the organic principle of order that makes the parts meaningful and measurable while determining their relationship to the whole. And on this we shall have to make a decision.[40]

Perhaps the most singular example of an architect coherently bringing together this range of conceptions of the organic is a leading German contemporary of Hans Scharoun (whose work is also articulated through a related conception of the organic), Hugo Häring.[41] Victoria Watson has suggested that:

> Häring believed that the new modern culture would be characterised by a much deeper and more profound understanding of the relationship between man and nature and by an intensification of that relationship through a new awareness of 'creativity'. Häring believed that both in nature and in works created by human artifice there is an expressive relationship between the form and the content of the created work and that the outward appearance of a creation of nature, or a work of art, is the sensuous embodiment of a vital inner determination.[42]

In fact, through this conception of *organic form*, Häring makes a significant new addition to the conception of an aesthetic process as a meta-relationship between "subject" and "object". Watson notes, in terms that resonate with my interests in empathy, and Bateson's ecological aesthetics, that "for Häring aesthetic experience consists in the subjective recognition of a vital inner determination in the object of experience."[43] Nonetheless, in so far as modernist artists and architects were interested in exploring and figuring dynamism

Organic Architectures

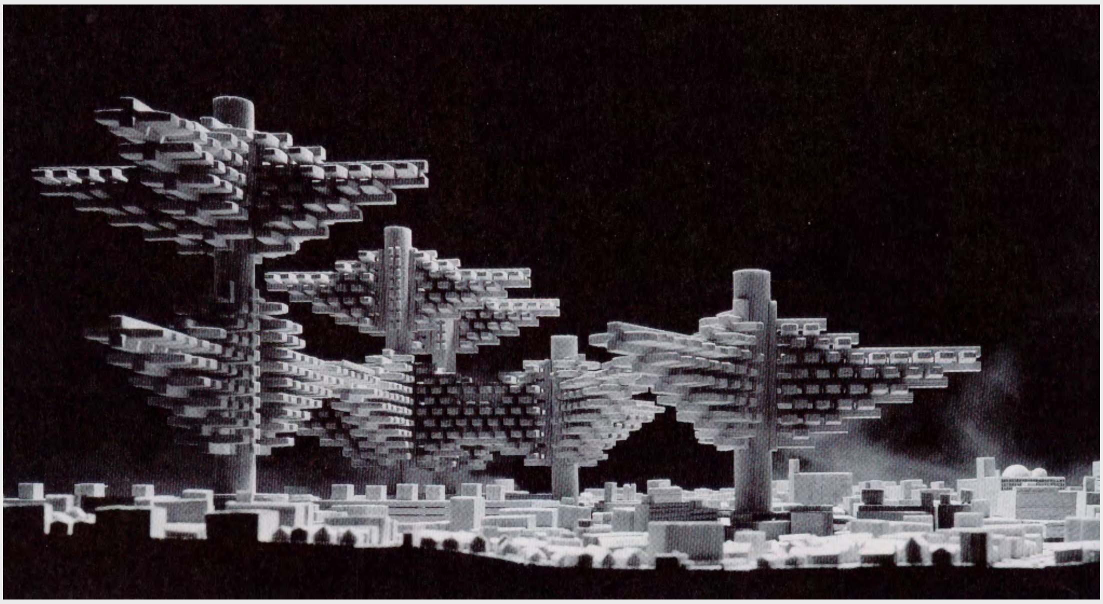


Fig. 3.4. Arata Isozaki, Clusters in the Air in 1960-62 for Tokyo. The Metabolist architecture group pioneered one attempt to think about human built environments as metabolic ecological systems, and their work has obvious resonance with that of the British Archigram group. Metabolist theory found an interesting holist philosophical expression in the written work of Kisho Kurokawa, which he referred to as the philosophy of symbiosis.

Fig. 3.5 [C]space - the AA DRL pavilion, 2008, designed and developed by Alan Dempsey and Alvin Huang with engineers Adams Kara Taylor. The DRL's engagement with organicism is not restricted to formal description, but can be found, in also the sense described by Reinhold Martin above.

in general, they were inevitably drawn to formal explorations that shared all kinds of topological and morphological seams with biomorphic aesthetics (such as in Art Nouveau).[44] Indeed, in the case of Mendelsohn, his engagement with organicism primarily explored a related field of form (literally, in that his work seems to owe as much to the morphogenetic coordinate drawings in D'arcy Thompson's 1917 book *On Growth and Form* as it does to biomimesis directly) to express and intensify the dynamism of metropolitan ecologies.

The continuing popularity of the term "organic" as a description of form in architectural discourse comes in waves – a decade or so ago, at the start of the CAD revolution, it was everywhere. More recently, it seems to have been replaced by a series of related terms, including emergence, ecology, biomimesis, etc. In any case, the broader modernist conception of an socio-organic project for architecture seems to be just as present today as it was for Mies, Häring and Mandelsohn. Consider, for example, this statement by Farshid Moussavi of Foreign Office Architects:

> Architecture needs mechanisms that allow it to become connected to culture. It achieves this by continually capturing the forces that shape society, as material to work with. Architecture's materiality is a composite one, made up of visible as well as invisible forces. Progress in architecture occurs through new concepts by which it becomes connected with this material, and it manifests itself in new aesthetic compositions and affects. It is these new affects that allow us to constantly engage with the city in new ways.[45]

In addition to these conceptions of the organic in architecture, there is of course a long tradition in thinking about buildings, and particularly cities, *as organisms*. This tradition might include Engels's comments on the emergence of segregated quarters in Manchester as well as Patrick Geddes observations at the birth of modern urban planning. More recently, Richard Sennett is one theorist who has again drawn upon this metaphor. The post-war Japanese Metabolist movement in architecture considered the urban and the architectural as metabolic systems, where the metabolisms involved included personal, social and cosmological orders. In a particularly vivid illustration, the Dutch architect Kas Oosterhuis has argued that we can see the house as a living organism if we

shift our perception to a different temporality. He suggests that a film of a house in use speeded up would look like an organism:

> ... it absorbs all kinds of material, including a liquid stream of humans, pulsating in and out. It absorbs and it excretes them in a rhythmic pulsating manner ... Since we are captured in our arbitrary speed of life we are unable to experience the consistency of other life forms which are living at a completely different pace.[46]

In this sense, the modern metropolis comes close to fitting the definition of autopoetic, which the cybernetic biologists Humberto Maturana and Francisco Varela define as being sufficient to defining life: “living systems are ... physical autopoietic machines: they transform matter into themselves in a manner such that the product of their operation is their own organisation.”[47]

Manuel de Landa has recently reproduced a version of the city as an autopoietic organism, observing that cities are like islands. Firstly, he argues they are islands of heat, and secondly, like islands, that their food-webs and their ecosystems are simplified. “Islands tend to be unstable ecosystems, because there are very few niches filled,”[48] de Landa notes, adding that this “lack of resiliency” is also true for the food webs of cities. Borrowing a phrase from von Bertallanfy (and more recently Ilya Prigogine and Isabelle Stengers), he suggests that “cities are unstable ecosystems far from equilibrium.”[49] This of course “runs counter to the romantic view of cities held by nineteenth-century social thinkers, in which cities were seen as organisms in functional harmony. Today we know that neither nature nor cities are in harmony.” [50]

This kind of thinking about cities as living organisms might then be divided into analytic and operative forms. The first uses lessons from the organisational principles of organic biology to understand the processes of metropolitan growth. The second tries to implement these principles to guide future action. In both cases, there is always an unavoidable ideological character to such thinking, although again this can take on many forms. For instance, the aim might be to reveal how urban processes left unchecked become inextricably linked to, and constitutive of, the unfolding of broader social and political forces. It is often however used with more utopian intentions, such as when organic thinking is elided with the kind of sentiment that Barry Commoner expressed in

the statement “nature always knows best.” It is here, when the model of the natural organism is valorised uncritically, that we can get into trouble, in two ways. Firstly, by misunderstanding and mis-valorising the natural, we can allow conceptions of nature to ideologically obscure broader socio-economic forces (making capitalism seem natural, for example).[51] In a more subtle way, it also tends to lead to the too hasty rejection of organic systems thinking by those critical enough to have observed the first error! It seems to me that it is in moving beyond these problematic conceptions of nature that the work of Gregory Bateson can be useful. Bateson was always attentive to the way in which it is perfectly “natural” for organic systems to become pathological; that organic or natural does not in any simple way equal “good”. As he once remarked, “nature is a dirty double-binding bitch!”[52] One task today, it seems to me, is to find a way of working critically with organic systems thinking in urbanism, architecture and design practice, in a manner that does not succumb to simplistic valorisation, whether positive or negative.

Ultimately for Rykwert, “no identifiable organic theory of architecture … can usefully be summarised. Yet the constant appeal to the notion of organism, particularly as it related to the body image in architecture, seems to be an important recurring theme in speculation about building.” He goes on to suggest that if the concept of organicism in architecture can be separated from simplistic vegetative mimesis, then “the wider importance of a conception of organism will perhaps then be seen as central to architectural thinking.”[53]

We can find, in the decade since Rykwert made the above statement, at least two responses to the challenge he raised. One is in fact to be found in a recent anthology that includes Rykwert’s paper. Branham and Hale’s collection, *Rethinking Technology*, seems on the surface to be a generalised reader in architectural technology, but it is actually, in effect, an explicit argument that architectural technology has nothing *per se* to do with structural engineering, or building services, or anything like that, but is rather a broader engagement with and theorisation of “processes, networks and systems” – a task that any “wider conception of organism” demanded by Rykwert is indeed central to.

A second response can be found in Reinhold Martin’s conception of what he refers to as “the organisational complex” – the elision between the application of cybernetics in corporate management and organisational theory, and the systems thinking in information

and communication theory explored by several generations of post-war American artists and architects; a condition which he sees as fairly ubiquitous in that phase of capitalist modernity. For Martin, “the susceptibility of vast regions of modernist discourse to the designation ‘organicist’ is what renders the term nearly useless or meaningless but also supplies it with the potency of indexing that which is taken to be self-evident.”[54] Martin examines the notion that rather than organic society (in the sense elaborated by Lukács) being an exclusively pre-capitalist condition, modern capitalism has instantiated an all-too-organic society in which an organisational form of “re-enchantment” mediates the interests of corporate power. As Martin states:

> ... the organisational complex can be described as the aesthetic and technological extension of ... the “military-industrial complex”. Its defining epistemologies coalesce into an organicism that operates on the model of a total pliant system. Within this system architecture acts as a conduit for organisational patterns passing through the networks of communication that constitute the systems infrastructure. The system’s phantasmagorias – with built architecture also counted prominently amongst these – likewise constitute an indelibly real system of images, with indelibly real consequences. Far from simply staging a spectacle ... architecture works here to integrate spaces and subjects into naturalised organisations.[55]

3.5 Ecology, Organism and Metabolism

In recent years (just as it did in the 1960s and 70s), the term *ecology* has replaced organic as the word of choice amongst architectural academics to capture a systems network approach, with an associated sense of some kind of response to the broader “environmental question”.[56] The growing adoption of this term within architectural theory is in line with an ever-expanding ecosystem of ecology sub-disciplines and concepts, which include human, social, deep, and political ecology.

Although, as noted, the word was first coined in print by Haeckel, it seems likely to have come into use at a few places concurrently. Ecology, Haeckel stated, “is the study of all those complex interrelations referred to by Darwin as the conditions of the struggle for existence. This science of ecology, often inaccurately referred to as “biology” in a narrow

sense, has thus far formed the principle component of what is commonly referred to as "natural history"."[57]

Our understanding of the relations between organisms has shifted dramatically since then, such that Capra can state that "today we know that most organisms are not only members of ecological communities but are also complex ecosystems themselves, containing a host of smaller organisms that have considerable autonomy and yet are integrated harmoniously into the functioning of the whole."[58] Nonetheless, the basic systems approach of ecology has remained and in fact been extended. Indeed, today, unsurprisingly, "ecology" is used to refer to any complex system, whether natural or not.[59] The word is originally derived from Greek *oikos,* meaning household, and ecology might thus be translated as both the science of running a home and the science of running an economy. Ecology thus shares with architecture this relation between dwelling and economics. It also internalises many of the same complex contradictions that are familiar to architecture.

Ecology as we understand it today emerged in part out of classical modern science, yet in many ways it also started to challenge the epistemological basis of those very roots. It does exist as a hard science, yet it also has allegiances with modern environmentalism in a broader sense that, as David Pepper has pointed out, gives it an irreducible complexity. As such, ecology includes many of the insights of mechanistic science, but now combined with intellectual, religious and romantic legacies, ideas and practices that are from beyond the enlightenment tradition (either predating it and/or taken from remote cultures.)

Ecology was thus one of a series of disciplines – others would include environmental studies and geography – that were defined at the metabolic interface of capitalist production and the planet in the nineteenth century.[60] Donald Worster has suggested that ecology has both arcadian and imperialist roots, a double lineage that characterises many individual thinkers (such as Darwin), as well as ecological thought as a whole. Certainly, the need to understand the dramatic environmental changes brought about or at least dreamed of by capitalist production, meant that proto-capitalist organisations such as the Dutch and British East India Companies started employing scientists in this capacity from the late-eighteenth century.[61] Both Harvey and Foster

Macroscopes and Geoscopes

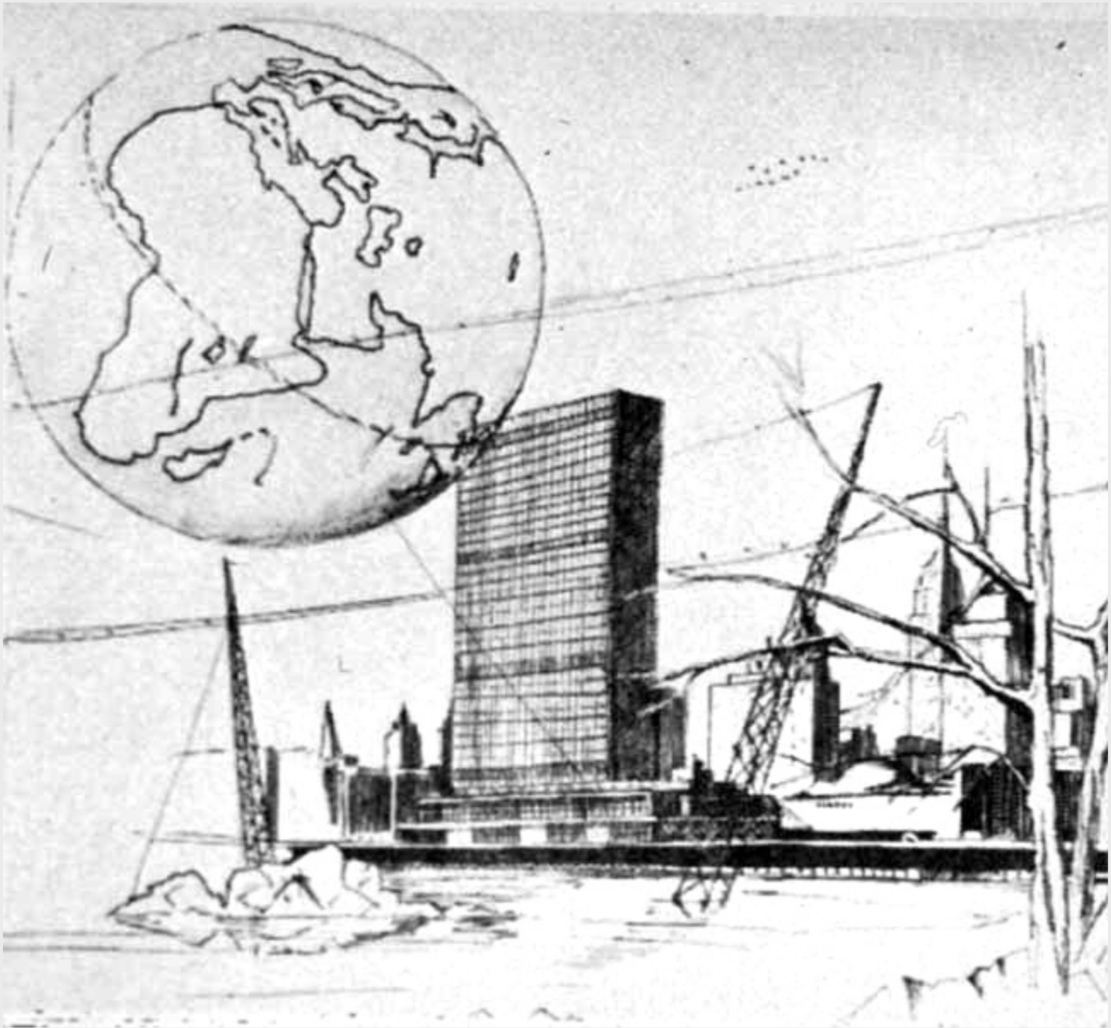


Fig. 3.6. Buckminster Fuller, Geoscope Concept drawing (1962). A particular form of systems-organicism was developed by Fuller, who was obsessed with visualising planetary systems, emphasising our need to realise that our planet is a spaceship – “Spaceship Earth” he called it – whose life support systems need to be maintained. He proposed the Geoscope: a series of mapping systems displayed upon a 200 ft diameter 3D globe display system, with a proposed 10 million light-pixel spherical display surface, for visualising the interconnection of human and natural flows around the planet.

This 200-foot-size Geoscope would make it possible for humans to identify the true scale of themselves and their activities on this planet. Humans could thus comprehend much more readily that their personal survival problems related intimately to all humanity's survival.
The Geoscope's electronic computers will store all relevant inventories of world data arranged chronologically, in the order and spacing of discovery, as they have occurred throughout all known history.
Historical patterns too slow for the human eye to comprehend, such as the multimillions-of-years-to-transpire changes in the geology of our planet -- for instance, the picturing on the Geoscope Earth in two minutes of the drifting apart of the continental plates.
Or in another four-minute sequence picturing, the last four one-million-years each ice ages, spaced 250,000 years apart, their transforming of the world's oceans into ice cappings, which water shifts reveals peninsulas interconnecting what we now know only as islands -- for instance, the Malay Peninsula including all of Java, Sumatra, Borneo, Bali, Sulawesi, and the Philippines, as it did in the last ice age.

More recently, the design theorist John Thackara has talked about the need for macroscopes: “A macroscope is something that helps us see what the aggregation of many small actions looks like when added together.”[85]

remind us that in many ways the “metabolic rift” that capitalism instantiates was *more* obvious in the nineteenth century than it is today (even considering issues such as climate change). For example, the break in the nutrient cycle that the division between city and country produced meant that by the early-nineteenth century Britain’s soil had become largely infertile, as all of the nutrients had moved from country to city in the form of food, and then from the city to the sea as sewage. Britain started digging up the soil of old graveyards (mostly foreign) and importing organic matter from the empire and beyond (such as guano from South America) in order to acquire nutrients to keep its soil alive. As Justus von Liebig, the German natural scientist who founded organic chemistry and whose work was very important to Marx, noted:

> Great Britain ... deprives all countries of the conditions of their fertility. It has raked up the battlefields of Leipzig, Waterloo and the Crimea; it has consumed the bones of many generations accumulated in the catacombs of Sicily; and now annually destroys the food for a future generation of three millions and a half of people. Like a vampire it hangs on the breast of Europe, and even the world, sucking its lifeblood without any real necessity or permanent gain for itself.[62]

Liebig in fact invented the concept of artificial fertiliser as a result, which fixed the nutrient cycle problem for a century, but which has arguably returned to us as a problem with multiplied force again today.

3.6 Ecology: An Economics of Nature?

In fact, “ecology” shares much more than an etymological root with “economy”. There are a series of key concepts common to both, most notably those of *growth* and *circulation*.[63] Marx introduced some more organic terms into political economy, most importantly *metabolism* – a term which has been taken on by a new generation of thinkers today (notably Eric Swyngedouw). But, beyond that, ecology is in important ways an *economics of nature*, as indeed is suggested in one of the early proto-ecological texts, Linnaeus’ *Oeconomy of Nature* (1749), and was then confirmed in Haeckel, who stated in

Ecological Mappings: Abstracting Flows

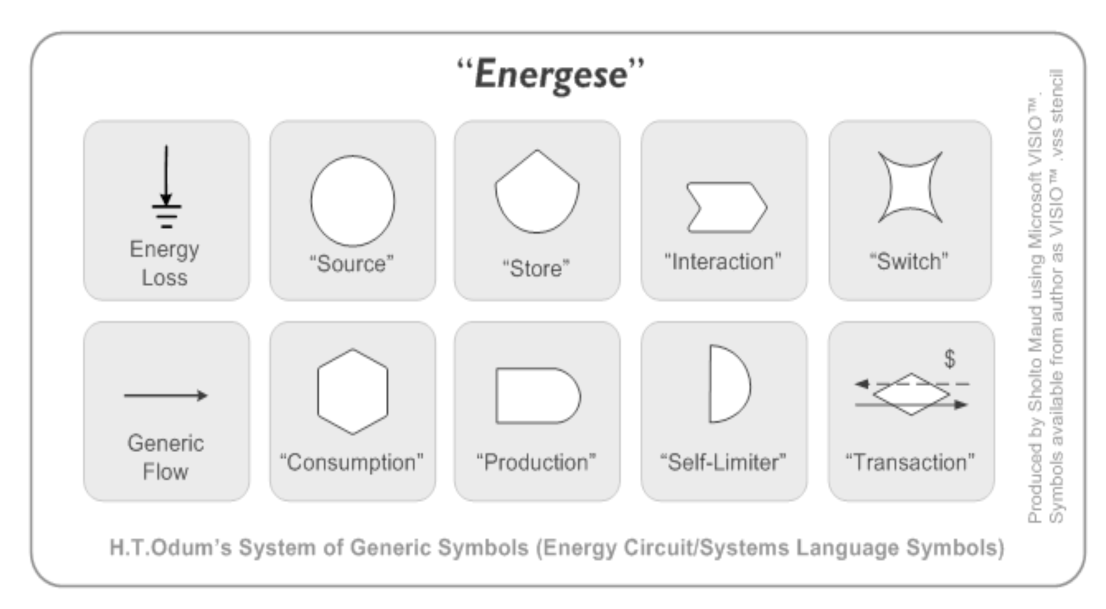


Fig. 3.7. Energese was a systems notation devised by Howard T. Odum, which aimed at making commensurate human and natural systems, and was intended to provide what he described as a macroscopic language. However, for Gregory Bateson, ecologists such as the Odum brothers were still too mechanical in their thinking and presumptions of control.

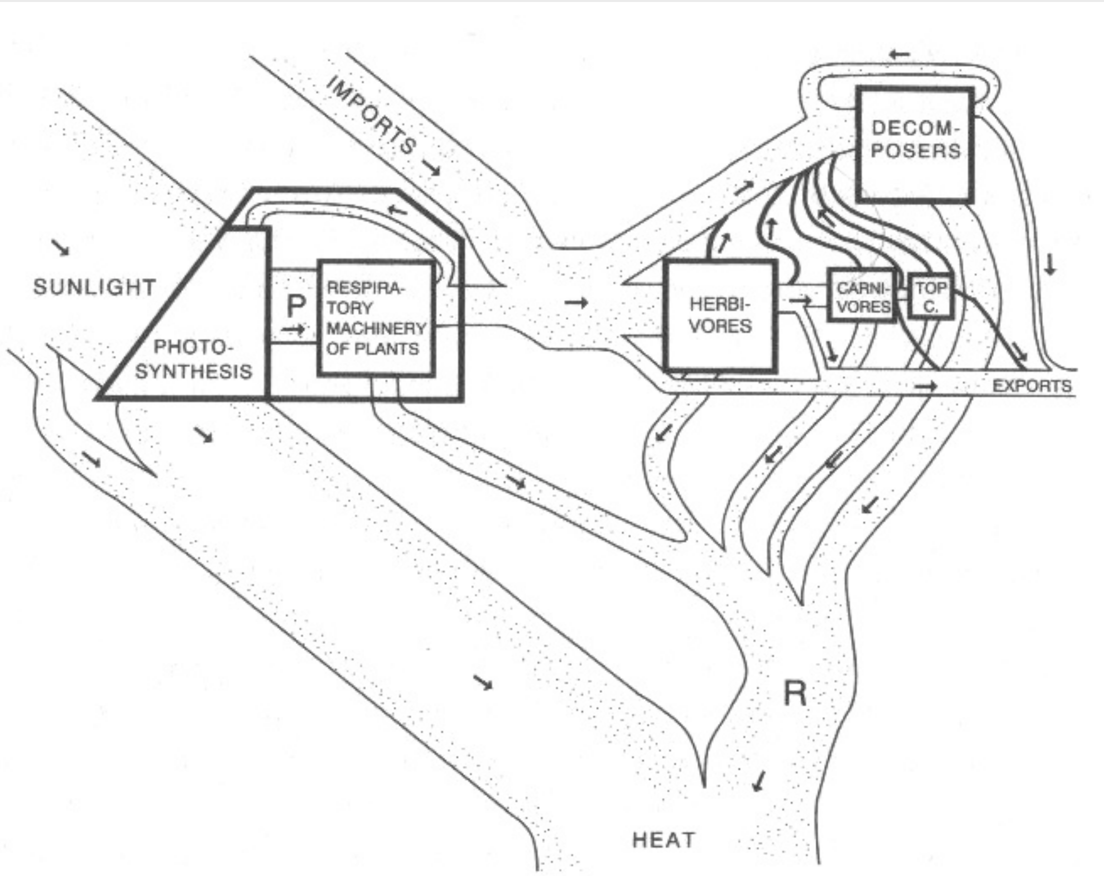


Fig. 3.8. Ecological Energetics diagrams, by Eugene Odum: Silver Springs Study (1950s): energy and matter flows through an ecosystem, from the Silver Springs model. (H are herbivores, C are carnivores, TC are top carnivores, and D are decomposers. Squares represent biotic pools and ovals are fluxes or energy or nutrients from the system.)

his initial definition that “by ecology we mean the body of knowledge concerning the economy of nature.”[64]

In the post-war period Eugene Odum adopted the term “ecosystem”.[65] In the book on *Fundamentals of Ecology* written in 1953 with his brother Howard T. Odum, they started to describe and analyse flows of matter and energy through ecosystems as simple flow diagrams. As Pepper notes of their insights:

> ... energy and matter flow along pathways within a system before leaving it, and for an open system there is much exchange of matter between it and the environment, whereas a closed system is characterised by maximum recycling of material ... Mature ecosystems (eg Apalachian forests) display high organisation (ie minimal entropy) because they are more diverse than immature ecosystems. They have more species and more niches are filled, and they are able to capture more matter and slow down energy dissipation.[66]

Howard T. Odum, especially, pioneered theories and practices around systems ecology and ecological energetics, which included studies of human-natural systems economics.[67] This later developed into the concept of “emergy”, which studies the role that embodied energy plays in systems. He himself noted that “the study of energy in nature does not necessarily imply an economic framework. But that is the way it is has been assimilated.”[68] Gerald Marten has suggested that:

> ... it is useful to distinguish three major kinds of ecosystems. Natural ecosystems organise themselves. Their outputs for human use include renewable natural resources such as wood, fish and water. Agricultural and urban ecosystems are organised in part by human inputs of materials, energy and information. The rest of their organisation comes from the same self-organising processes that form natural ecosystems.[69]

It was in order to facilitate the study of energy flows as they move through these different natural and social, ecological and economic systems, that Howard T. Odum developed the concept of *Energese*, a diagramatic energy systems language.[70]

Howard T. Odum’s attempts to generate out of ecology a universal systems language paralleled similar attempts on the part of other systems thinkers of the same

time, most notably perhaps Buckminster Fuller. It has also been compared to Gottfried Leibniz's attempts to develop a 'universal language system' (*characteristica universalis*) which would facilitate the transmission of concepts between mathematics, science and metaphysics. However, it was more in line with the general lead that ecology and biology has taken in systems thinking since the nineteenth century. The Odum brothers' conception of ecosystems has been an immensely powerful concept for organising thinking about the web of life and the human metabolic relations within it.

3.7 Ecology: An Epistemology of Dwelling?

However, the single most innovative and important re-conception of the *project* of ecology emerged in the late work of Gregory Bateson, in particular starting in the mid-1960s. Whilst I will consider the development of Bateson's position more thoroughly in the coming chapters, it is important to note that for Bateson the tendency of the Odum brothers and others (such as Jay Forrester's MIT-based Systems Dynamics research group, which produced the analysis for the Club of Rome's famous *Limits to Growth* in 1972) to focus primarily on energy and material flows in ecological science was problematic, for two reasons. Firstly, Bateson considered that ecosystems had to be considered to be *communicating and informational* systems, at least as much as they were material and energetic systems.[71] Ecologists were, he suggested, "overemphasising energy exchange and attending insufficiently to information exchange."[72] Secondly, he stressed that to properly understand ecosystems, we need to find ways to *think ecologically*, recognising ourselves as a part of the system that is being observed or interacted with. In line with Bateson's broader critique of science, he argued that these errors were compounded within even more erroneous instrumentalising tendencies, repeatedly emphasising that ultimately in complex systems a part can never control the whole. As Harries-Jones has noted:

> Bateson realised far ahead of his contemporaries that the primary source of error in ecological science lay in false presumptions of an ability to 'control' and 'manage' ecosystems through quantitative measurement.[73]

The Whole Earth from Apollo 8: An Ecology of Mind

Fig. 3.9. Image of Earth seen from moon. Photograph taken by astronaut William Anders of Apollo 8 in 1968. Gregory Bateson's former student and supporter, Stewart Brand, had been campaigning since 1966 for NASA to release an image of the whole Earth, and had been joined in this by Buckminster Fuller amongst others. The release of this image is widely thought to have been a material factor in the growth of the environmental movement and counter-culture during that period. This artefact significantly “extended “ and “embodied” the human mind (a theme I will develop further in later chapters).

Bateson argues then that there are major conceptual errors in our conception of our *relation to nature.* We totally mis-comprehend *the form of the relationality* (what in Marx's terms we might describe as the relational nature of our species being), Bateson contended. For Bateson, ecology, like western science in general, suffered from its instrumentalisation - in two directions. Firstly, by attempting to instrumentalise ecological knowledge in the interest of human social and economic systems, we can fail to recognise the immanent subjectivities of systems under consideration. The second sense of instrumentalisation is that in the re-organisation of human environments into technical networks and flows, we can all too easily allow the human to become instrumentalised by the system. Whilst this is perhaps a more common observation today, Bateson's analysis prefigured contemporary readings such as Bruno Latour's, in important ways. A more political critique of ecological science might typically point out that science is ultimately, in the words of the dialectical biologist Richard Levins, the "product of a specific social structure that supports and constrains science and directs it towards the goals of its owners." In the case of ecological sciences under capitalism, these owners goals would typically include the production of knowledge that facilitates the managing and controlling of resource flows, for example. Bateson's critique is actually slightly different from this, although it shares many of the conclusions. However ultimately for Bateson, the problem is "epistemological" rather than "political".

Bateson's position is broadly in line with standard ecocentric – and to a lesser extent romantic – critiques of the "Promethean" attitude of western science towards a nature that is treated as if there to exploit, control and dominate, Bateson's critique is distinct from more recent Deep Ecology positions which argue that to conceive of ourselves in opposition to nature is simply morally wrong. It is also distinct from a standard Marxian position which would describe the opposition to nature, or our alienation from nature, as a historical condition, related solely to capitalist conditions of production. For Bateson, the situation is more complex, in that whilst his position encompasses a recognition of the specific socio-historical form of our relation to nature (i.e. the Marxian position), and the ethics of it (the ecocentric position), he argues that the primary problem is *epistemological* – in other words, a systemic false consciousness of our relation to nature that is now a part of our ecological condition.

Over five days in October 1970, Gregory Bateson convened and chaired a conference entitled “Restructuring the Ecology of a Great City”.[74] The conference brought together planners, ecologists and systems theorists in the office of John Lindsay, Mayor of New York City, to explore possible components of an ecological theory of the city. Bateson’s paper of the same name was published in the third issue of the art/media theory journal, *Radical Software*, in Spring 1971.[75] Importantly, Bateson concluded his seminal 1972 collected essays, *Steps to an Ecology of Mind*, with a reworked version of this paper on urbanism.[76] Whilst I will consider in greater detail the content of Bateson’s paper on urbanism and planning in the final chapter, I think that it is worth reflecting further upon this ecological turn towards the city, and to consider more broadly the relation between a possible *project of ecology* as a form and practice of knowledge, and the *concept of the metropolis*.

Mark Wigley has suggested that “ecology is, from the beginning, a certain kind of thinking about or from architecture.”[77] Indeed, as has already been noted, the root of ecology – *oikos* – suggests something like *a knowledge of dwelling*. What though is it that ecology might grasp with regard to dwelling? We need to approach this question, I propose, through the concept of the metropolis. David Cunningham notes that “the philosophical interest of the concept of metropolis lies in its presentation as a determinate negation of the city as a historically specific form of the urban.”[78] That is to say, the term metropolis describes both an entirely new concrete urban condition that emerges within capitalism, and, at the same time, describes the very processes that give rise to it. Within the relational spacetime terms set out in Chapter One, the concept of metropolis describes a distinct condition, given that the metropolis is both “the primary space ‘in’ which exchange happens” (ie. in absolute space and relative space-time as outlined by Harvey), even whilst it “designates the general processes by which space itself is formed or produced by exchange”[79] (in relational spacetime).

Many of the usual examples of urban “relations to nature” (Carcasonne for example) typically show a series of conditions based upon a clear opposition between city and country. This city/country opposition can be described within an absolute spatial framework: there is city on one side of the wall, and countryside on the other. The metropolis however, is not defined in any simple way in opposition to “country” in the

sense that the earlier concept of a city was. In terms of absolute space, metropolitan nature and culture are co-extensive: the metropolis understood in this way is planetary in reach, by definition. However, the city/country opposition is not resolved by this realisation – it clearly persists – rather, the metropolis is a concept operating at another (global) level of abstraction. There is a sense then in which we might conclude that the metropolitan stands in the same relation to the idea of city as the ecological does to the countryside. This still does not quite capture it though. Cunningham, in response to Lefebvre's "theoretical need" to think about the urban, suggests that the kind of trans-disciplinary "post-philosophy" that can rethink the metropolis would necessarily share something of the pattern-form of the metropolis itself. In fact, I wonder whether the kind of knowledge that a theoretical account of the metropolis would produce – knowledge that would surely be shaped by our complex metabolic relations to nature to an extent not appreciated by Lefebvre – might even take on the name of *ecology*? I do not of course refer to the often dismal bourgeois science of ecology as it exists today, but rather the aesthetically re-conceived ecology as proposed by Bateson.

Developed from his reading of C. S. Pierce, Bateson worked with a dialectical process of *abduction*, which, rather like Lefebvre's concrete abstraction, is "that 'kind of development' of the concept which ('more fruitful than classical deduction, and suppler than induction or construction') leads from (abstract) thought, via increasing determinants, towards the 'rich totality' of relations and mediations."[80] For Bateson, this approach made visible the "patterns that connect" the mental ecologies immanent within differential organised material systems.[81] This suggests I think an additional and necessary dimension to the conception of metropolitan mediation: i.e. the metropolis as precisely *the pattern that connects nature and culture*.[82] Writing forty years after Bateson's meeting with the New York planners, David Harvey has increasingly come to promote an associated re-reading of Lefebvre's *Right to the City*, stating that:

> ... the city has to be viewed as a metabolic and ecological system in its own right and therefore as a vibrant and increasingly dominant part of the natural world we inhabit. While there is, in my view, nothing unnatural about New York City, the qualities of the urban environments we create are a major concern and those

> qualities are not confined to what humans need but also to preserving the whole life-system upon which we ultimately depend.[83]

Yet the complex pattern that connects ecology and dwelling and the metropolis has barely been theorised. As Wigley reminds us, our very conceptions of dwelling necessarily contain suppressed relations of "domestic" violence, and that this observation is just as true of houses or cities conceived at a planetary scale. He suggests that "rather than simply reapplying ecological discourse to design, some of the perennial enigmas of the house that architects explore could be used to rethink ecology. The discourse can be rewired."[84] It is to this rewiring of ecological thinking that I now turn.

4 Cybernetics and Systems Theory

4.1 Pattern and Matter

> We may therefore regard matter as being constituted by regions of space in which the field is extremely intense - there is no place in this new kind of physics for both the field and matter, for the field is the only reality.[1]
> [Albert Einstein]

Matter and Pattern – triggering the questions "What are things made of?" and "How are they organised?" – have, as Gregory Bateson observed, tended to be treated as separate entities within the dominant traditions of western thought. Yet the interdependence of these questions has repeatedly resurfaced in modern sciences. In the life sciences, patterns of organisation are increasingly key to our very definitions of life, whilst, in modern physics, matter can best be defined as a pattern of energy in the spacetime field. As Erwin Schrödinger, one of the founders of quantum mechanics, put it, "what we observe as material bodies and forces are nothing but shapes and variations in the structure of space. Particles are just *schaumkommen* (appearances)."[2] Schrödinger wrote this sentence in English, and inserted *schaumkommen* in German, which does not translate as "appearances" as it might seem, but rather means "foam bubbles" or something like that. Material particles are not fundamental, Schrödinger is saying. It is better to think of material particles as patterns that emerge from and are immanent within, the fabric of spacetime.

The concepts of "matter" and "pattern" are themselves more fundamentally connected than it might at first appear. "Pattern" has its roots in the Middle English word "patron", in the sense of something serving as a model. The idea of a pattern book of designs, of a template which can be copied, therefore uses the word in exactly this original sense. The word patron comes via Old French and from the Latin "pater", meaning "father". The word "matter" also has its roots in Middle English, and comes via Old French from the Latin "materia" meaning "timber, substance" and also "subject of discourse"; ultimately the word derives from the Latin "mater" meaning "mother". So, we have pattern and matter, mother and father.

Network Structures

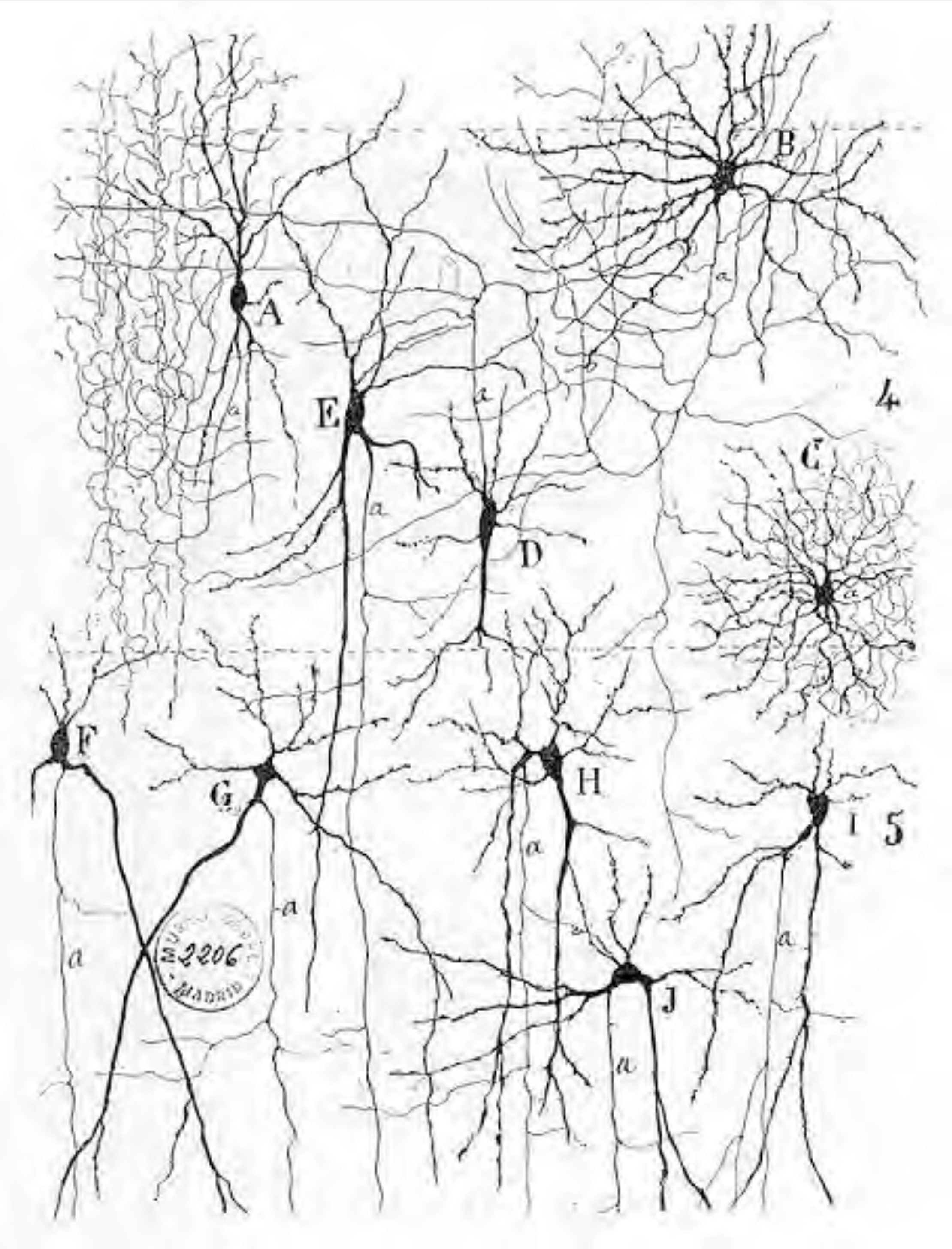


Fig. 4.1. Santiago Ramón y Cajal, drawing of Purkinje cells (A) and granule cells (B) of pigeon cerebellum, 1899.

Whilst it is widely observed that the concept of matter has all kinds of maternal or feminine cultural connotations, the pairing of matter with pattern is not often made. In the classical philosophical formulation, which typically opposes the term “form” (or “mind”) instead of “pattern” to “matter”, the gendered nature of the pairing tends to be less obvious.[3] For Plato, form was to found in the realm of the ideal, a realm which matter can only aspire to reflect imperfectly. As Susannah Hagan points out:

> ... in the Timaeus, Plato sought to explain the origins and structure of the universe, and in so doing, gendered the explanation, so that the creation of the world and its staggering variety begins with ideal ‘Form’, and enters the world as material objects through the ‘Chora’. Form is described as male, the father and model of the material object. The Chora is female, a ‘kind of womb for material existence’, the ‘place or space’ which functions as a receptacle, mother and nurse. Form is superior to the mere container that is the Chora, as the male is superior to the female.[4]

For Katie Lloyd-Thomas, this opposition – what she calls the “grip of hylomorphism” – is reproduced through the form-giving role of the architect, whereby “the practice of architecture and the discourses surrounding it are ... structured around a distinction between form and matter where the formal (and conceptual) is valued over the material.”[5] This critique by Lloyd-Thomas regarding architecture in some way mirrors a similar critique of cybernetics developed in particular by Kathryn Hayles: i.e. that cybernetics can appear to over-valorise virtual or immaterial pattern and information over matter.[6] Ultimately, our conception of “matter” is more closely related to our broader conception of “nature”, and our conception of nature is produced through our social relationship with nature – which as Marx was at pains to emphasise, is determined in important ways by social relations within human society.

4.2 Systems and Networks

Perhaps the single most important concept to have emerged out of biological systems thinking has been that of the network: “ecology is networks ... to understand ecosystems will be to understand networks.”[7] For Arne Naess, the Deep Ecology conception of an

Networks and Internal Relations

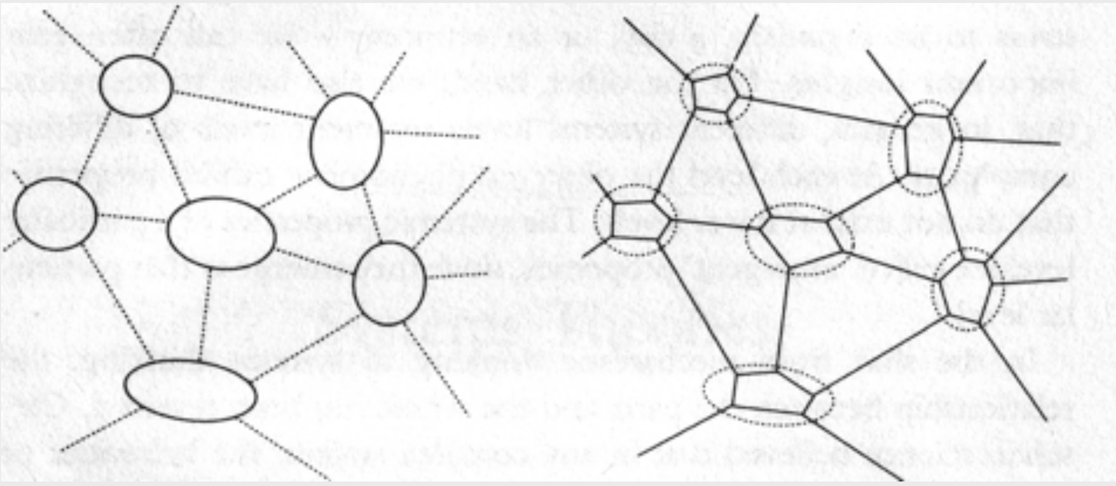
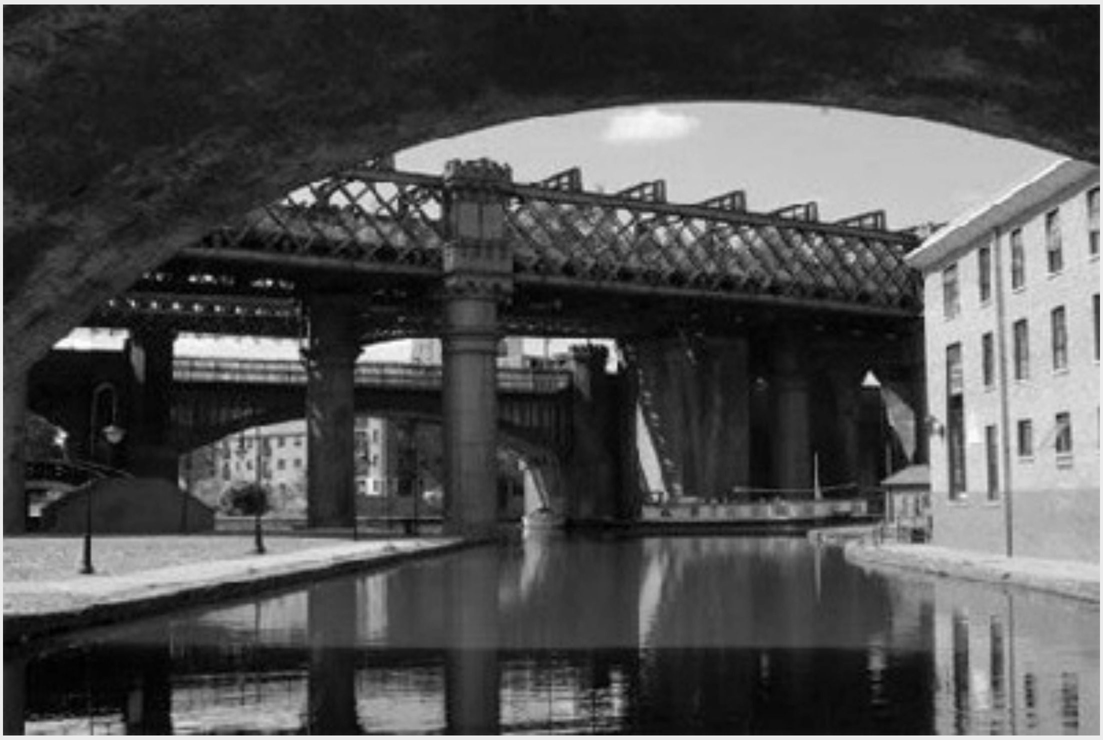


Fig. 4.2. Networks and internal relations. A network which first appears as a series of objects/ nodes and relations (left), but where a further examination of the nodes (right) reveals them to simply be more relations.

Fig. 4.3. Railway bridges passing over canal junction, at Castlefield, Manchester. It was from here that the now global modern network infrastructure started to spread.



environment can be defined as “networks or fields of relations in which things participate and from which they cannot be isolated.”[8]

Today, following in particular the work of the Spanish sociologist, Manuel Castells, we think of the network as a sociological concept for grasping the cultural, informational and economic forms of capitalism. However, this is just one of many recent use of the term. The word “net” has old English and Germanic roots, describing types of fabric structures relating to clothing, fishing and so on. The first use of network came, according to the Oxford English Dictionary, in 1658 in reference to “reticulate structures in animals and plants.” In the mid-nineteenth century it started to be used to describe transportation infrastructure. First, in 1839 it was used to refer to rivers and canals, and from the late-1860s to railways. It spreads to include a network of electrical cables in 1883, and in 1914 the first wireless broadcasting network.[9]

Some of the earliest functional network structures studied were the neural networks drawn by the pioneering Spanish neurologist, Santiago Ramón y Cajal, at the end of the nineteenth century. The organisational structures of neurons remains one of the most important examples of a *configurational technology* embodied in a material substrate, and the study of neuronal networks initiated much of the impetus which would feed cybernetic research.

Within systems biology, the concept of networks facilitated a series of insights into the economics of ecosystem flows. An ecosystem can be thought of as something like a fractal network. An ecosystem is a series of interconnected nodes, in which each node is, for example, an organism. However, if we zoom in on one of these nodes, we see that this too is merely a network of organs and other organisms, and so on, all defined by their internal and external relationships. Capra has shown that:

> ... as the network concept became more and more prominent in ecology, systems thinkers began to use networks models at all systems levels, viewing organisms as networks of systems, just as ecosystems are understood as networks of individual organisms. Correspondingly, the flows of matter and energy through ecosystems were perceived as the continuation of the metabolic pathways through organisms.[10]

Network Structures

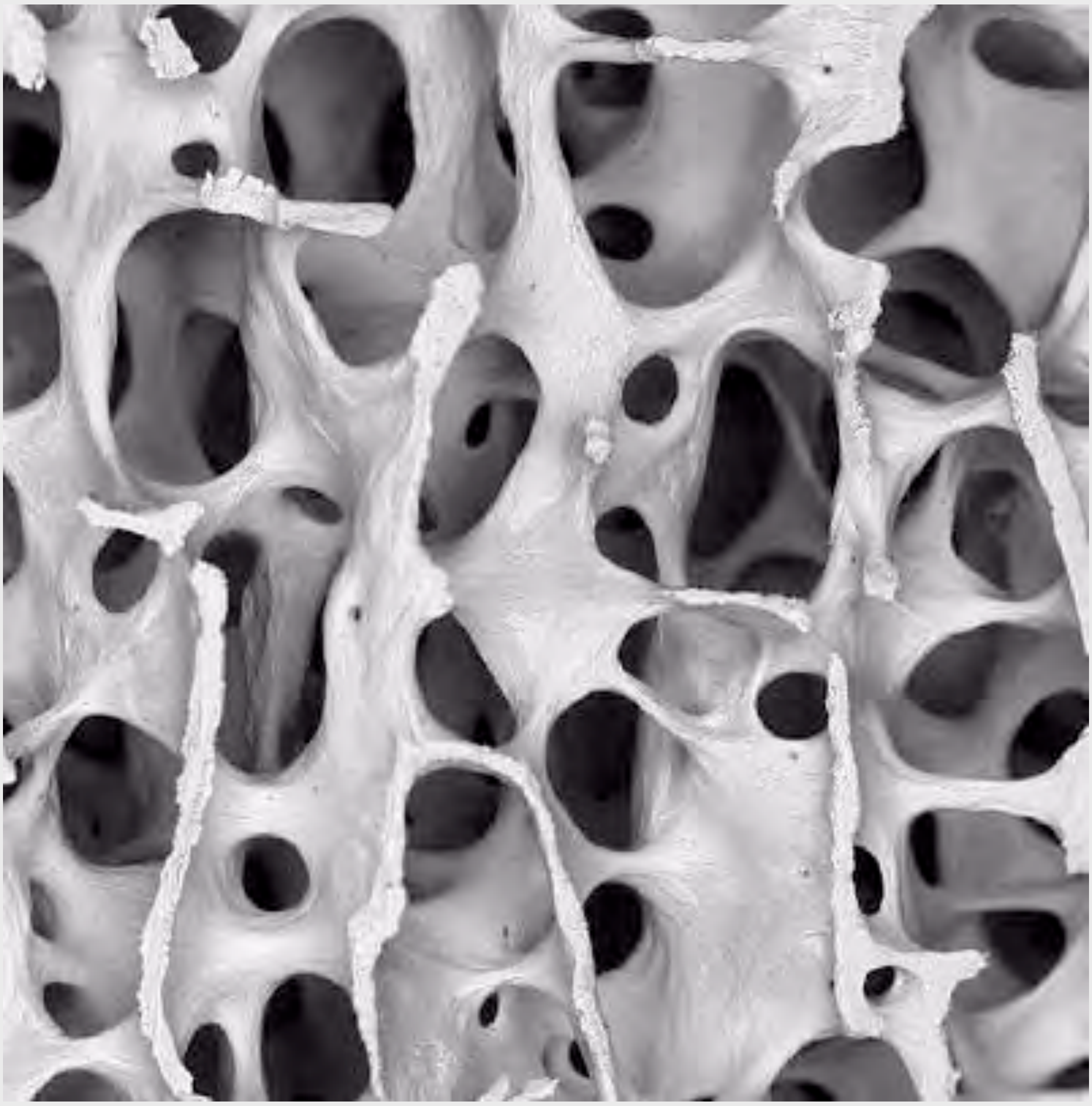
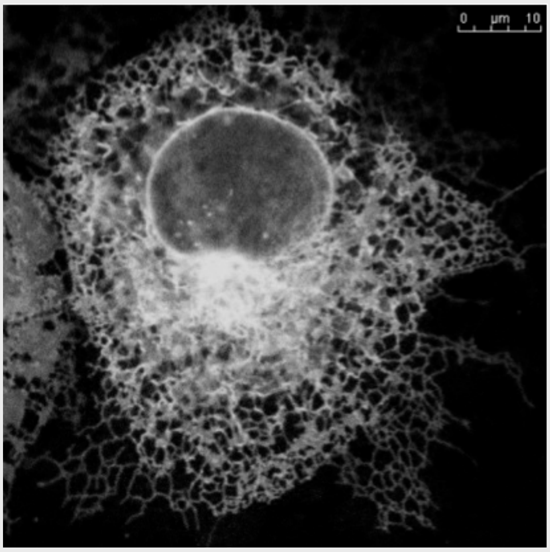
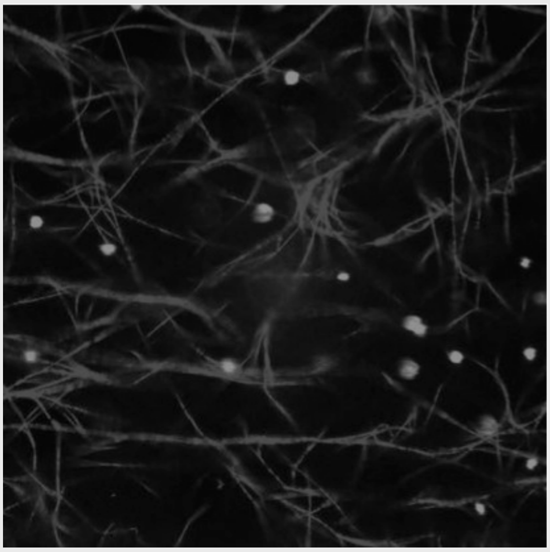


Fig. 4.4. A structural network (a bone interior)
Fig. 4.5. and 4.6. Biological neural nets.





The study and use of networks became one of the most important trans-disciplinary moments within system theory. Aas Mark Buchanan has observed:

> ... networks of things of all kinds – atoms, molecules, species, people, and even ideas – have a marked tendency to organise themselves along similar lines. On the basis of this insight, scientists are finally beginning to .. see patterns at work where they have never seen them before.[11]

In recent decades the discourse around *political ecology* has considered how capitalism produces a particular set of networked flows of energy and matter, and I turn to consider this further in the concluding chapter.

4.2a General Complex Systems

By the first decades of the twentieth century, many of the key initial systems concepts were in place primarily through organismic biologists and ecologists, and these relational paradigms were supported by emerging work in areas as diverse as gestalt psychology, relativity and quantum physics.[12] If the possibility of a conscious general systems theory was first given expression through the architectural ideology of the Renaissance, such as in Alberti's writings, and reverberated throughout the nineteenth century in everything from aesthetics to organicism, having been given a particularly clear (but ideologically impossible for capitalism to use) expression in the work of Marx and Engels, then by the early-twentieth century it had acquired an indisputable if initially marginal presence across all of the sciences.

It is widely considered that the first attempt at consolidating the emerging forms of trans-disciplinary knowledge around organisational systems was conceived by the Viennese (later American) biologist, Ludwig von Bertalanffy.[13] As a biologist, Bertalanffy's most interesting work concerned the realisation that living organisms appear to evolve and live in the opposite direction to entropy, the second law of thermodynamics.[14] Although Bertalanffy was not the first to realise this fact, he was the first to grasp that it was because whilst entropy held true in closed systems which move towards homogenous equilibrium, living organisms are systems which are in fact open (i.e. there is a flow of

energy and matter passing through them) and stable, but *far from equilibrium*. Within organisms, energy and matter become *more* organised, not less. He stated that:

> ... the organism is not a static system closed to the outside and always containing identical components; it is an open system in a (quasi-) steady state ... in which material continually enters from, and leaves into, the outside environment.[15]

From the 1930s onwards, Bertalanffy engaged in developing what he finally published in 1968 as his book on *General Systems Theory*, which he suggested was possible because of the fact that "the parallelism of general conceptions or even special laws in different fields is a consequence of the fact that these are concerned with 'systems', and that certain principles apply to systems irrespective of their nature."[16] He defined General Systems Theory (GST) as:

> ... a general science of 'wholeness' which up till now was conceived as a vague, hazy, and semi-metaphysical concept. In elaborate form it would be a mathematical discipline, in itself purely formal but applicable to the various empirical sciences. For sciences concerned with 'organised wholes', it would be of similar significance to that which probability theory has for sciences concerned with 'chance events'.[17]

Clearly, systems theory in this sense has some positivistic aspects, in that it seeks a universal science (indeed, Bertalanffy in his youth was a part of the "Vienna Circle"). Overall, however, systems theory counters the reductivism which characterised previous positivistic approaches, which, for example, would argue that biological systems are reducible to physical systems. Systems theory proposes the opposite of this, arguing that, through organisation, the whole system creates properties which do not exist when the system is reduced. Nonetheless, it can be argued (by for example those advocating a more dialectical position) that general systems approaches can themselves be characterised by another paradoxical kind of reductionism, in that they focus on wholes and a certain level of organisational abstraction, without any methodological need to move between concrete and abstract, or between specific and systemic.[18]

As we shall see, GST shares much with the cybernetics movement which emerged in the mid-1940s, and in many situations today the two terms can be used

interchangeably, (moreover, they can both often be swapped with ecology also.) For Francis Heylighen, “each can be seen as part of an overall attempt to forge a transdisciplinary ‘Systems Science’.”[19] Nonetheless, there are key differences between the two approaches. Specifically, cybernetics formed itself around a particular series of research questions concerning recursion and information feedback, and the challenges that this poses for traditional causal logic – whereas GST is concerned with all systems, whether or not they exhibit feedback. For Bertalanffy and some others this meant that cybernetics was simply a subset of GST.[20] Bertalanffy specifically makes a point of distinguishing between the areas in noting the influence of cybernetics: "Systems theory is frequently identified with cybernetics and control theory. This again is incorrect. Cybernetics as the theory of control mechanisms in technology and nature is founded on the concepts of information and feedback, but as part of a general theory of systems."[21] However, many cyberneticians consider that Gordon Pask demonstrated that general systems theory is in fact a proper subset of cybernetics.[22] More recent historians (such as Andrew Pickering) have suggested that the ascription of “control” to cybernetics is misleading, and have argued that cybernetic interests are better defined as research into the emergence of *agency* and *self* in systems, whether human or non-human.

It is in many ways a paradox of history that systems theory and cybernetics first developed (in any significant way) in the USA and Europe rather than the USSR, given the latter’s ideological and productive stake in systems practice – which for example in architecture has been seen as prefiguring parametric research today.[23] Indeed, whilst the Soviets did welcome Weiner’s work in his visits during the Macy period, what is less well known is that the Soviet Union did from the 1920s independently develop a systems theory – Tektology – but it was rejected in different ways by both Lenin and Stalin. Indeed, it has been suggested by Gorelik and others[24] that the work of Alexandr Bogdanov – principally his three volume *Tectology: Universal Organization Science*,[25] published in Russia between 1912 and 1917 – provided Ludwig von Bertalanffy with much of the material and method for his General Systems Theory.[26]

Bogdanov was a leading member of the Bolshevik Party in its earlier days. In fact, prior to the 1905 Revolution it has been argued that he was as important as Lenin. However, Bogdanov increasingly distanced himself from the party and immersed himself

in theoretical research and developed and published an ever broader systems theory, which he considered to be a contribution to Marxian dialectics.[27] Lenin's *Materialism and Empiriocriticism* (1909) was largely a critique (no doubt partly personally/politically-inspired) of Bogdanov's early work in this regard.

In any case, Bogdanov's *Tectology*, having been openly criticised first by Lenin, and then ultimately suppressed under Stalin, remained unknown in the west (apart from the 1928 German publication that Bertalanffy may have read). It also lay completely "forgotten" in the USSR until its rediscovery in the 1970s – although paradoxically by that time its aims had already re-entered the Soviet Union via American and West-European theorists in the guise of cybernetics and systems theory.

4.3 The Emergence of Cybernetics

Although cybernetics would enter some pretty abstract areas of thought, its core investment in the original sense of *organon* never wavered. For Katherine Hayles, cybernetics represents "an unprecedented synthesis of the organic and the mechanical."[28] As Francis Heylighen puts it clearly:

> Information Theory, Control Theory and Control Systems Engineering have since developed into independent disciplines. What distinguishes cybernetics is its emphasis on control and communication not only in engineered, artificial systems, but also in evolved, natural systems such as organisms and societies, which set their own goals, rather than being controlled by their creators.[29]

Whilst the two terms "ecology" and "cybernetics" are, as I have already noted, often used interchangeably, especially when talking about systems theory in general, they do nonetheless conjure up very different cultural associations. Cybernetics as noted carries suggestions of control and leadership, and in popular culture it has all kinds of associations with robots, machines and computers. Indeed, in science fiction and consumer marketing, the prefix "cyber-" is often used in order to create just that kind of association. In recent theory, the root of cybernetics has re-appeared in the figure of the "cyborg" – short for cybernetic organism – which has been evoked by many thinkers,

notably Donna Harroway and Andy Clark, in order to describe what is frequently referred to as a “post-human” condition.[30]

However, in an academic sense, the term does not refer to that at all. Cybernetics is rather primarily concerned with exploring what “mind” is, and how it works. It is historically defined by its research into and definition of characteristics such as system, pattern, information, organisation and ecology – whether in human, natural or technological contexts – and almost always featuring circular causality, or feedback. As such, cybernetics is a fundamentally trans-disciplinary subject. Indeed, Frank Fremont-Smith, who as head of the Josiah Macy Foundation which facilitated the Macy series of conferences which effectively founded modern cybernetics in the period immediately following the Second World War, expressly saw these events as an experiment in trans-disciplinary practice.

Etymologically, “cybernetics” is based on the Greek word for “helmsman”, and means “the art of steermanship”[31] – and this suggests that cybernetics is particularly interested in how systems are organised, how they operate, and how they set, or are given, goals. What qualifies as a system for cybernetics is primarily an *organisational* question, not a material question. It is for this reason that the Macy Conferences were a self-consciously cross-disciplinary event. The conferences drew together leading thinkers from anthropology, mathematics, ethnography, cognitive science, psychology and other fields, in order to ask, as Gregory Bateson would later put it, “*what is the pattern that connects?*” The answers were described through what Gordon Pask would characterise as “the art and science of the defensible metaphor.”[32]

Cybernetics is hence the study of underlying organisational order rather than, or in addition to, the specific material mechanism. As Ashby puts it, “cybernetics stands to the real machine – electronic, mechanical, neural, or economic – much as geometry stands to a real object in our terrestrial space.”[33] Stuart Umpleby has been responsible for popularising a conventional history and theory of cybernetics, primarily through the American Society for Cybernetics. He notes:

> ... because numerous systems in the living, social and technological world may be understood in this way, cybernetics cuts across many traditional disciplinary

> boundaries. The concepts which cyberneticians develop thus form a metadisciplinary language through which we may better understand and modify our world.[34]

Whilst then drawing upon a wide range of material in order to abstract out patterns of organisation, and informational flow, “the truths of cybernetics are not conditional on their being derived from some other branch of science. Cybernetics has its own foundations.”[35] Nonetheless, these have proved difficult to pin down. For instance, we find that in the case of leading thinkers like Humberto Maturana, cybernetics could be defined as “the science and art of understanding," whilst for Heinz von Foerster, it “interfaces hard competence with the hard problems of the soft sciences.”[36] In the view of Gregory Bateson, cybernetics quite simply was “the biggest bite out of the fruit of the tree of knowledge that mankind has taken in the last 2000 years.”[37]

There have been three main periods of development for cybernetics as a body of knowledge. The first period, which started during the early-1940s, is sometimes referred to as first-order cybernetics, and was largely formulated around the Macy Conferences. This period came to an end in the early-50s – although the key figures continued to develop and refine the key concepts and their applicability across a range of fields.[38] The second major period of development is often referred to as second-order cybernetics. Although this term has been used by various commentators to refer both to conceptual and generational shifts, it is generally understood to refer to an extension of cybernetic principles towards understanding the participatory role of the observer in observed systems.[39] This development is considered to have been first formalised in a paper by Margaret Mead, called “The Cybernetics of Cybernetics”, which was commissioned by Heinz von Foerster and published in 1968.[40] Whilst much of the conceptual content of second-order cybernetics regarding the active role of the observer had been developed by Mead, Bateson, and later von Foerster, throughout the period of the Macy Conferences, this insight gained a new importance in the work of a new generation of cybernetic thinkers. Above all, it is closely related to the development of social constructivist and structuralist thinking in the social sciences more generally. Indeed for many theorists in this group, such as Ranulph Glanville, second-order cybernetics is indistinguishable from

Gaia: An Ecology of Mind?

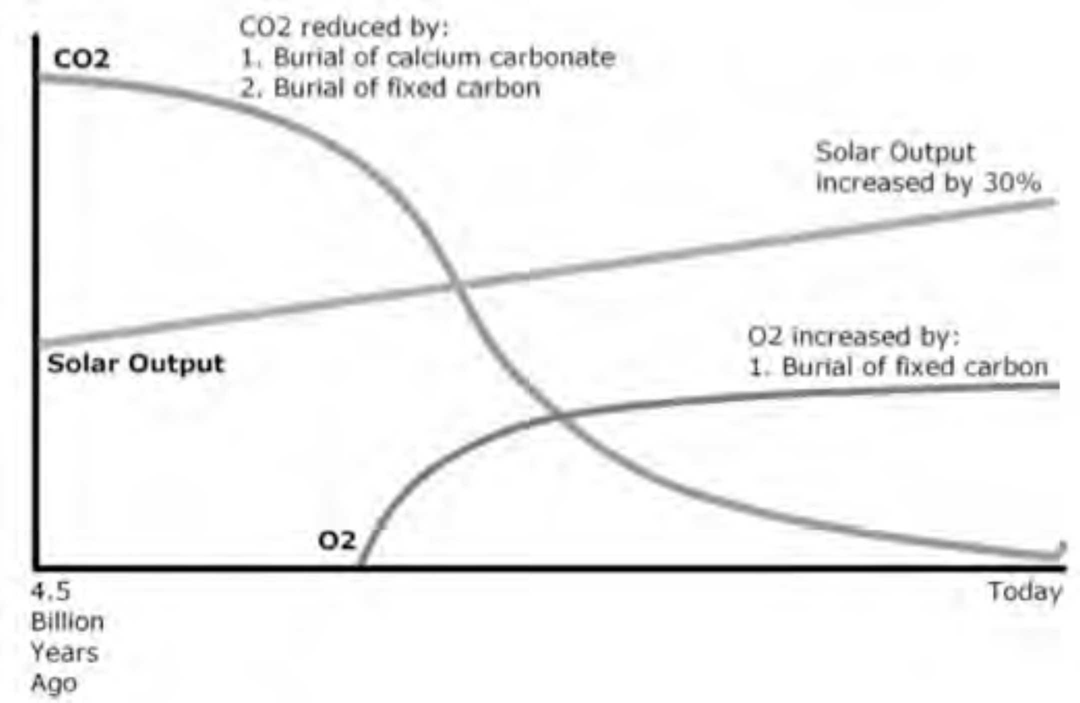


Fig. 4.7. Graph showing changing chemical composition of Earth's atmosphere with advent of living systems. Ecological Cybernetics becomes manifest in the work of James Lovelock, whose conception of Gaia emerged in work that he was doing at NASA. Lovelock was charged with devising experiments that future space missions to Mars might use to test for life. Whilst researching this, Lovelock realised that there were important, fundamental differences between the atmosphere on Mars and that on Earth, and that in principle, a study of any planetary atmosphere could be enough to detect whether large scale life existed on the planet (a discovery not necessarily popular with NASA as it potentially reduced the need for actual space missions!). Lovelock realised that the atmosphere on Mars was stable: there were no chemical reactions that could take place. Everything that could occur between the gases present had occurred, and they were essentially now resting in a stable equilibrium state. On the Earth, the opposite was the case. The atmosphere was made up of a volatile and unstable mixture of gases, which were maintained in a steady state, yet one that was dynamic, self-regulating and far-from-equilibrium. The earth's atmosphere was even composed of 20% oxygen, a molecule that is generally keen to combine with and oxidise almost anything, and which would need to be replenished constantly. The constitution of the Earth's atmosphere is itself a sign that something is *actively producing* the atmosphere, and that there must be life processes labouring on the planet. This realisation ultimately led Lovelock to formulate the Gaia hypothesis, which later, following its predictive success, is now referred to, by its supporters at least, as Gaia theory. This states that the planet as a whole system maintains itself in a state *far from equilibrium*, but most suited to its continuing survival as a system, as a super-organism: "the entire range of living matter on earth, from whales to viruses and from oaks to algae, could be regarded as constituting a single living entity capable of maintaining the earth's atmosphere to suit its overall needs and endowed with faculties and powers far beyond those of its constituent parts." It is important to note that the chapter on cybernetics is the largest and most important in Lovelock's book, and is the methodological foundation upon which the theory is built, as can be seen in the following definition of Gaia as "a complex entity involving the Earth's biosphere, atmosphere, oceans and soil; the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on this planet".[147] Whilst clearly there are parallels between Bateson's Ecology of Mind and Lovelock's Gaia hypothesis, there are important differences too. Lovelock's Gaia was published shortly before Bateson died, and he did not respond to it at any length, although was said to have criticisms. For an interesting Batesonian "critique" of the Gaia hypothesis see Chapter Five in Harries-Jones, *A Recursive Vision.* Lovelock himself makes some of these points in his more recent book on *The Revenge of Gaia* (2006).

radical constructivism.[41] In recent years in particular there has been growing re-adoption of the term neo-cybernetics.

There is, perhaps, now a third phase, which can be called *ecological cybernetics*.[42] It is characterised, I would argue, by a precisely ecological condition of cybernetic knowledge, and in a number of senses of the term ecological. Most obviously, cybernetics theory in various forms has become a key component in understanding and analysing ecological systems, both in terms of the new understandings of biological systems, and their interconnectedness with human economic and social systems that have emerged in recent decades. In James Lovelock's famous book on *Gaia*, for example, the chapter on "Cybernetics" is the intellectual keystone, from which Lovelock uses a series of cybernetic concepts to construct his argument that the Earth, as a planetary ecosystem, constitutes a self-regulating meta-organism or "mind". More broadly, however, ecological cybernetics describes a condition where the key concepts have been verified and used across a number of disciplines, while at the same time, many semi-independently developed sub-disciplines – such as chaos theory, catastrophe theory, complexity theory, emergence theory, embodied and extended mind theories – are themselves networked together. Today, a whole series of concepts formed through cybernetics and systems theory underlie all of these contemporary areas of research (even whilst as a term cybernetics might be rarely used). As I suggested in Chapter Two, these systems-theory-based sciences have in complex ways fed from, and back into, organic and process philosophies more generally.

Equally, as I will discuss further later, cybernetics and systems thinking were inseparable from both radical and counter-cultural tendencies, but paradoxically were also key to the emerging strategies for corporate, national and international management, as driven by developing ICT technologies. Cybernetics provided the basis of the first ecological reports into the problems of ongoing capitalist growth and development (Jay Forrester's System Dynamics/Club of Rome *Limits to Growth*) – yet it also transformed the basis of those very systems of capitalist management and the intensification of development. There were certainly some military and secret intelligence funded research that was aimed at exploring the potential for government control over the minds of the population, and John von Neumann in particular had close connections into the heart of

The Cybernetic Arts of "Ontological Theatre"

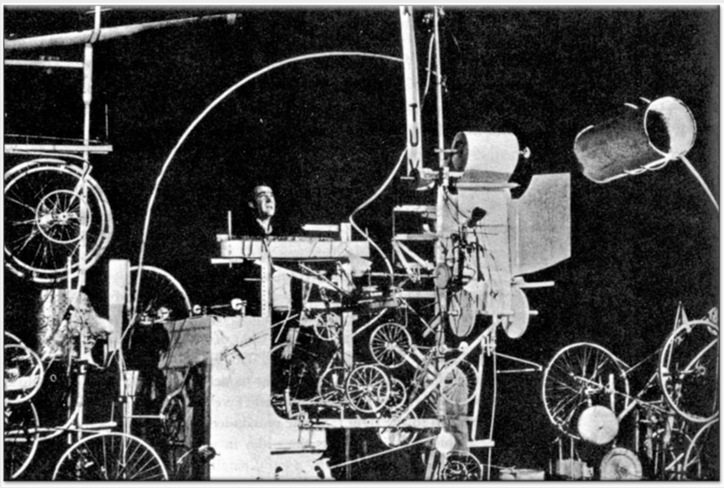


Fig. 4.8. Gordon Pask, 'Colloquy of Mobiles', in *Cybernetic Serendipity* exhibition at ICA London, 1968.
Fig. 4.9. Jean Tinguely (with engineer Billy Klüver), a 'self-destructing kinetic sculpture' at MOMA New York, 1960.

Fig. 4.10. Nam June Paik, 'TV Garden' at Documenta 6 in Kassel, 1974.

the US military-industrial complex. Equally however, the more “nomadic” tendency within cybernetics staged some of the most radical political and even “spiritual” explorations and extensions of what it means to be alive.

The development of cybernetics and systems theory within the arts and humanities has been complex, and also sits outside of a straightforward first-order/second-order classification. The high point of explicitly cybernetic art was in the mid-1960s, with figures from cybernetics such as Gregory Bateson and Gordon Pask regularly contributing to or inspiring radical art discourse – eg. Bateson is cited by Dan Graham as an important influence, whilst Stewart Brand’s *Whole Earth Catalogue* was a direct result of Bateson’s influence on Brand. Writers such as the Beat Poets, Thomas Pynchon and William Burroughs drew heavily upon its suggestions and methods, and seminal exhibitions, like Jasia Reichardt’s *Cybernetic Serendipity* exhibition at the ICA in 1968, featured work from Nam June Paik, Jean Tinguely, and Pask amongst others, .[43] Equally, within cultural theory and social science, there have been important theoretical developments that owe a huge debt to cybernetic thinking. As Bruce Clarke and Mark Hansen have noted:

> ... recent thinkers such as Michel Serres, Giles Deleuze, Felix Guattari, Donna Haraway, Bruno Latour and Isabelle Stengers, have deployed neocybernetic discourse extensively and transformatively. Neocybernetic discourse is central to current historical, interpretive, and theoretical investigations using concepts such as narrative, medium, assemblage, information, noise, network, and communication to remap the terrain of knowledge with reference to the operational boundaries of systems and their environments.[44]

Within architectural research in Britain, there is a history of both direct and indirect engagements with cybernetic theory.[45] In fact, architecture schools have provided a base for some of the more itinerant cybernetic thinkers, especially after the few established cybernetics departments in universities were closed down. This architectural research is not simply a representation or application of cybernetic thought, but also represents a distinct staging or performance of cybernetic research. More importantly, this work often brought to the fore the really radical component of cybernetic thought: that is, cybernetics as a self-reflexive system based on an experimental and performative critique of normative theories of control.

Architecture and Deuterolearning

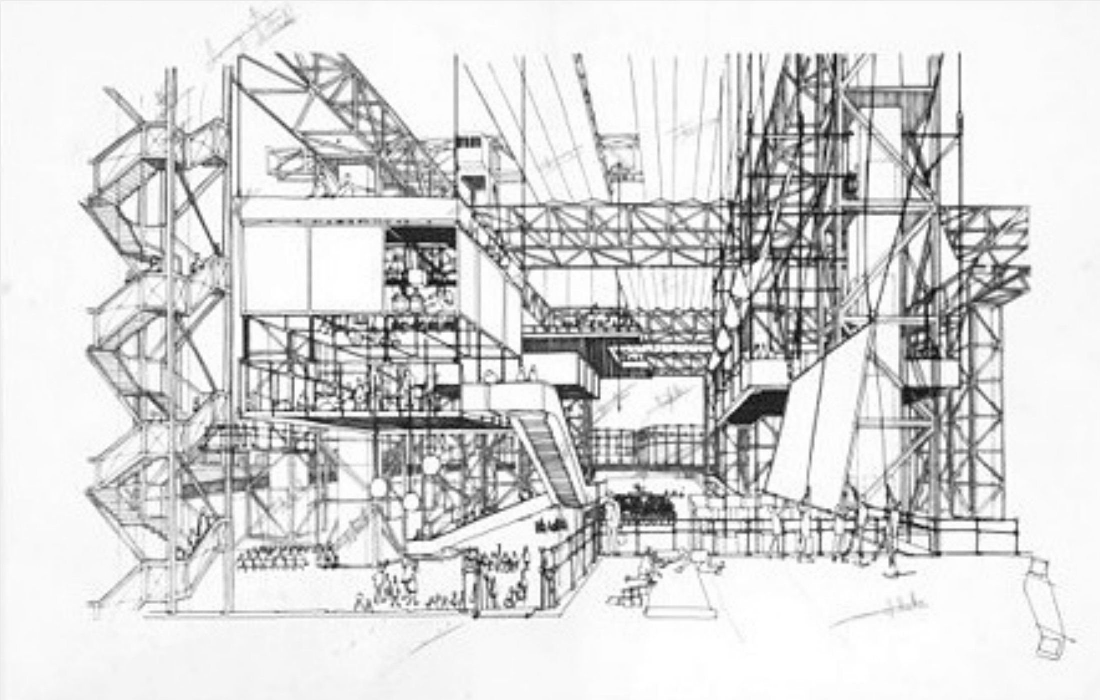


Fig. 4.11 Gordon Pask worked as a consultant with Cedric Price on the Fun Palace, designed for the radical theatre director Joan Littlewood. The building embodied many of Pask's ideas concerning interaction and conversation. Notably, the building had the capacity to become bored, and to make provocations. Indeed, in this respect the Fun Palace might be seen as a more "accurate" formulation of Situationist thinking articulated through design, than Constant's New Babylon.

Working with many of Bateson's insights on deuterolearning – or learning how to learn – Pask developed a series of cybernetic learning environments where a conversation is defined as requiring creativity on both sides to constantly reconstruct meaning. Ultimately this is necessary to avoid a total loss of information due to entropic noise that a non-creative conversation must inevitably collapse into.

Fig. 4.12 Sky Ear, by Usman Haque – one of the few contemporary interaction designers who have really grasped Pask's point that an interactive architecture is not the same as a responsive or reactive architecture.

Andrew Pickering has recently described as “ontological theatre” the “experiments” that were staged by a particular group of radical cyberneticians, notably Bateson again, but also Stafford Beer, Grey Walter, Gordon Pask and others. For Pickering, systems theory and cybernetics can be classified in a quite distinct way. Rather than referring to first-order and second-order phases, he suggests that the research can be divided into control and anti-control-based modalities. Pickering suggests that cybernetics proper – in contradistinction to the “enframing” character of systems theory – is best described as “anticontrol,”[46] a practice of “revealing” that stages “an ontology of becoming”[47]. It is impossible to grasp fully the issues at stake in the architectural, epistemological and ontological experiments that have emerged from this work without reviewing the history of cybernetic thought in further detail. In the brief history that follows I have tried to give a working account of first-order and second-order distinctions, and the criticisms of cybernetics that have emerged in recent decades. However, my conclusions have been broadly in line with Pickering’s recent account, which I will return to in my concluding chapter.

4.4 First-Order Cybernetics and the Macy Conferences 1947-53

The Macy Conferences ran over a period of six years from 1947 to 1953. There were ten conferences in all, which were initiated by Warren McCulloch, financed by the Josiah Macy Foundation, and held at the Beekman Hotel in New York City (except for the final event, which was at Princeton University). The Macy Conferences were small, almost seminar-like events, with never more than thirty participants. Warren McCulloch at that time was leading the world in using the concept of the network to model neural circuits in living organisms, and others were also doing leading work in this area. Notably, Norbert Weiner had similarly been observing the behaviour of network circuits, and would formalise the concept of feedback. John von Neumann had a decade earlier written a seminal paper on quantum mechanics. His ground-breaking research into computing would directly result in the modern digital computer as we know it today. Margaret Mead was already an important anthropologist, and as noted would play a central role in defining second-order cybernetics. Gregory Bateson was an important and independent

Macy Conferences

Fig. 4.13 and 4.14. A Macy Conference in session, and group photo (Margaret Mead in front row, Warren McCullouch to her left, and Gregory Bateson in rear row between them).

intellectual at the edge of the natural and social sciences. Beyond this core group of participants – who, with a few exceptions, attended all meetings – there were various significant guests invited (including, for example, von Beralanffy), some of whom subsequently became core group members.[48]

The inaugural Macy Conference was entitled ‘Feedback Mechanisms and Circular Causal Systems in Biological and Social Systems.’ The title shifted a few times over the following events, prior to the adoption of Norbert Weiner’s term “cybernetics” for the title of the seventh conference in 1949. Weiner had coined the term cybernetics as the title of this area of study, or way of thinking, in his book *Cybernetics: Control and Communication in the Animal and Machine*,[49] which was published in 1948,[50] although the term had first been used in the early-nineteenth century by André Marie Ampère in relation to political science.[51] The proceedings of the sixth to tenth Macy conferences were written up by Heinz von Foerster from 1949-55, and published as *Cybernetics: Transactions of the Conference*. In addition, in 1991 Steve Joshua Heims published *The Cybernetics Group,* an account of the period. Then in 1999 N. Katherine Hayles published an important new history of the subject, entitled *How We Became Posthuman*.

According to Gregory Bateson and Margaret Mead, the impetus for the Macy conferences started in 1942, with the publication of the paper on ‘Behavior, Purpose and Teleology’ by Arturo Rosenblueth, Norbert Wiener and Julian Bigelow, and the first meeting organised under the Macy umbrella, entitled ‘Cerebral Inhibition’.[52] The paper introduced the concept of “feedback”, and was according to Bateson, “a solution to the problem of *purpose*”[53] in the behaviour of organisms and machines. Bateson realised that Weiner’s concept of feedback was closely related to the concept of “schismogenesis”, which he had developed in *Naven*, his account of the anthropological fieldwork that he and Margaret Mead conducted with the Iatmul people of Bali, published back in 1936. He states “we didn’t realise then (at least I didn’t realise it, though McCulloch might have) that the whole of logic would have to be reconstructed for recursiveness.”[54]

Attending this preliminary 1942 meeting were many of the individuals who would form the core group of the later Macy Conferences,[55] and it was here that the concept of feedback was further discussed “over lunch.” According to Mead, by the end of this event, Bateson “really had the design of what needed to be done.”[56]

Although the key discussants were kept apart by conditions during the Second World War, Bateson maintained a friendship and correspondence with Warren McCulloch, and it seems that they each developed plans to ask the Josiah Macy Foundation to support an interdisciplinary research project. Bateson recounts how:

> ... just before going overseas, I had met Warren McCulloch and [Julian] Bigelow, who were all excited about 'feedback' in electronic machinery. So, while I was overseas, and mostly bored and frustrated, I occasionally comforted myself by thinking about the properties of closed self-corrective circuits. On arrival back in NY I went straight to the Macy Foundation to ask for a conference on these things. Fremont-Smith said 'McCulloch was here a week ago with the same request, and he's going to be the chairman.' Membership in these conferences, with Norbert Weiner, John von Neumann, McCulloch and the rest, was one of the great events in my life. Weiner coined the term 'cybernetics' for what it was we were discussing.[57]

The initial meeting in 1947 provoked an intense period of development. The group met again in October of the same year, and before this second Macy meeting, Bateson organised a sub-conference under the title of "Teleological Mechanisms in Society", and Frank another one after, both of which were aimed at developing further a social science based understanding of these cybernetic ideas. As Margaret Mead remembered:

> ... there were three groups of people. There were the mathematicians and physicists – people trained in the physical sciences, who were very, very precise in what they wanted to think about. There was a small group of us, anthropologists and psychiatrists, who were trained to know enough about psychology in groups so we knew what was happening, and could use it, and disallow it. And then there were two or three gossips in the middle, who were very simple people who had a lot of loose intuition and no discipline to what they were doing. In a sense it was the most interesting conference I've ever been in, because nobody knew how to manage these things yet.[58]

Writing in 1958 in the preface to the second edition of his pre-war anthropological work, *Naven*, Bateson reflected upon the first decade of cybernetic research:

> ... we now have the beginnings of a general theory of process and change, adaptation and pathology.. .and, in terms of the general theory, we have to

Walterian Beings

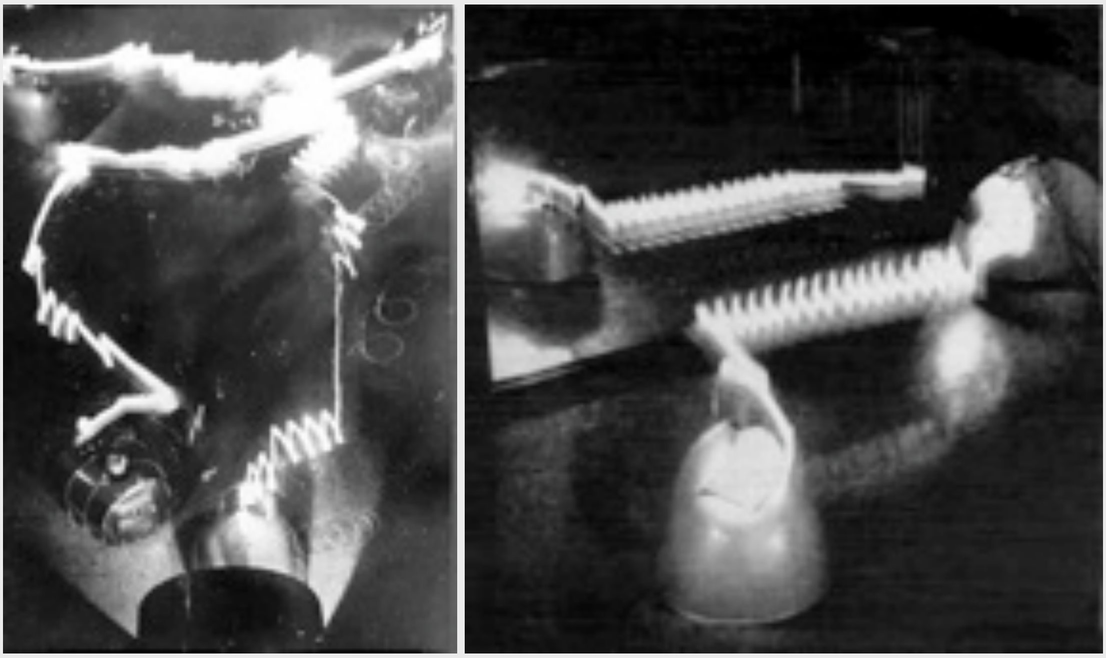


Fig. 4.15 4.16 and 4.17. Grey Walter’s “tortoises”, ELSIE and ELMER, which exhibited complex lifelike behaviour when encountering each other, or a mirror.

> reexamine all that we thought we knew about organisms, societies, families, personal relationships, ecological systems, servo-mechanisms, and the like.[59]

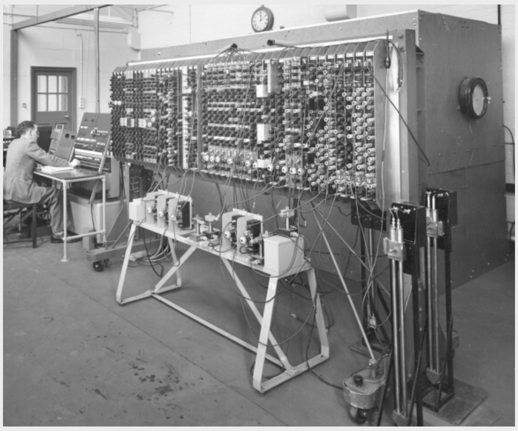
4.5 The Ratio Club

An English parallel to the Macy Conferences was the Ratio Club, an interdisciplinary dining club which according to Margaret Boden "started independently of the transatlantic version."[60] The Ratio Club emerged from the *Society of Experimental Biology* in Cambridge, and included several members of Alan Turing's war-time group from Bletchley Park who had broken the Enigma Code, and a group of academics at Cambridge, who had clustered around the proto-cybernetician, Kenneth Craik. The Ratio Club met from 1949 to 1958, and was led and instigated by the neurologist John Bates.[61] It included Horace Barlow (visual neuroscientist), W.E. Hick (experimental psychology and ergonomics), William Grey Walter (neurophysiology and robotics), Alan Turing (mathematics and computing), and Ross Ashby (mathematics, electronics). There were many links between the Macy and Ratio groups. Warren McCulloch was invited to speak at the first Ratio meeting, whilst Ross Ashby attended the ninth Macy Conference in March 1952, and Grey Walter the final Macy event in April 1953.

The group was perhaps more practical and hands-on than their counterparts based in the United States.[62] Alan Turing had of course by this time already built a working mechanical computer, and Grey Walter would build the two electronic "tortoises" ELSIE and ELMER.[63] These devices would star in the 1951 Festival of Britain exhibition on London's South Bank. Each of them had a sensor that responded to light sources, with different responses (approach or retreat), depending upon the brightness. However, each robot also had a light source itself, which produced complex behaviour when the two robots then interacted with each other, or with themselves in a mirror (as we shall repeatedly see, mirrors, literal or conceptual, seem to play a crucial role in thinking about and constructing mind).

Of this group, Ross Ashby went on to align himself with much of the Macy research, and he wrote a series of seminal cybernetics texts. Alan Turing was perhaps the

Turing and Ashby: Computation and Self-Regulation



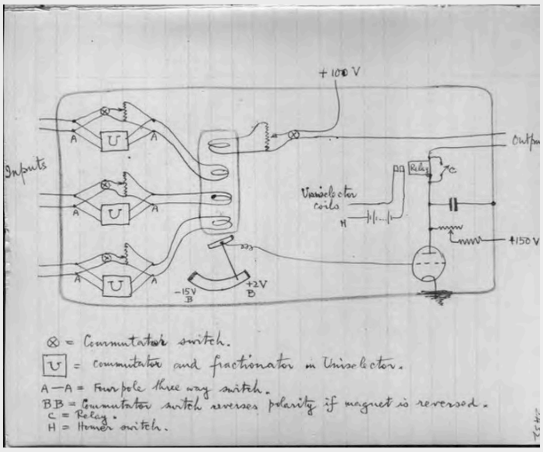
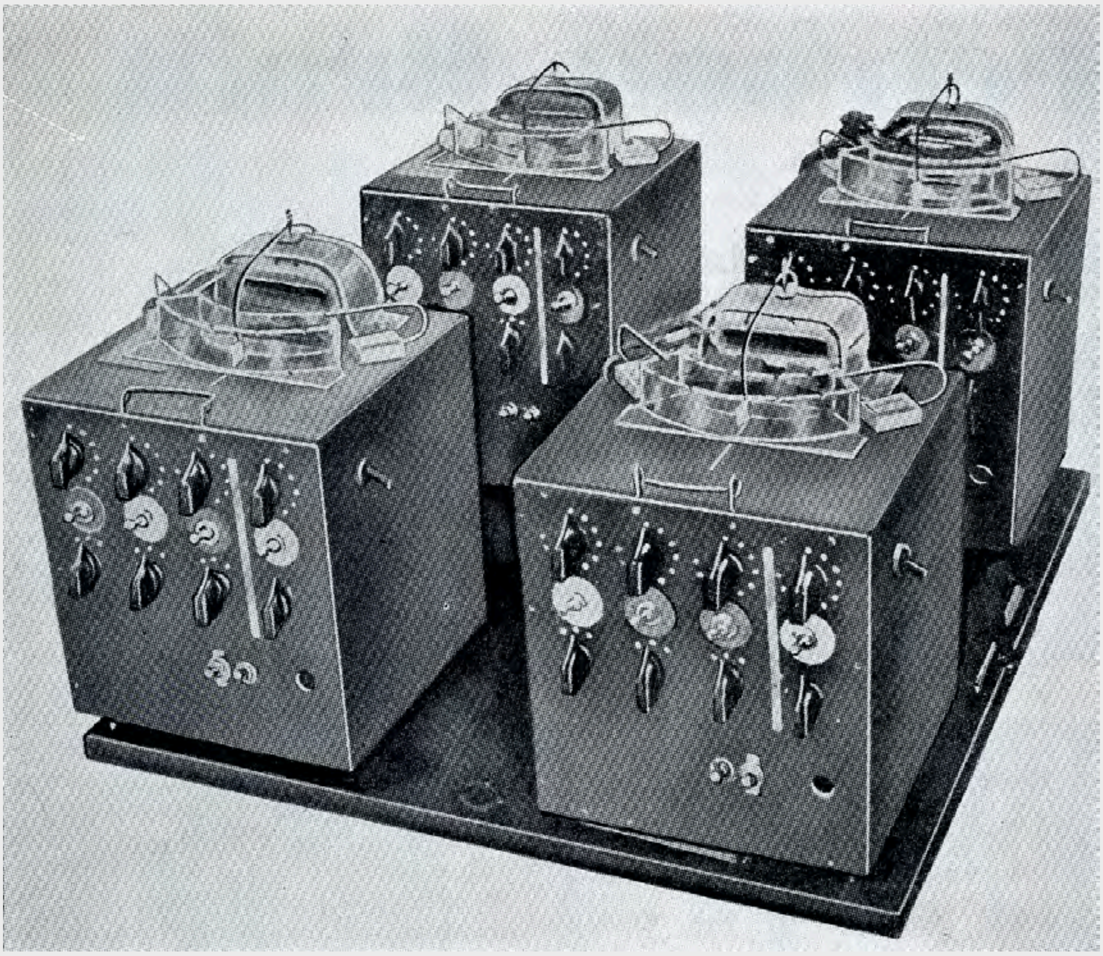


Fig. 4.18 The NPL (National Physical Laboratory) ACE Pilot computer designed by Alan Turing, 1945-50

Fig. 4.19 and 4.20. Ashby’s Homeostat – a demonstration model of a self-regulating system, compose of four interconnected Royal Air Force bomb control units with inputs, feedback, and magnetically-driven, water-filled potentiometers.



closest to Bateson's sense of the broader applicability of the concepts of mind that were emerging in cybernetics to the systems of the natural world more generally. It is often forgotten that Turing also produced an extraordinary study on *Morphogenesis*,[64] an enquiry into pattern, growth and form in plants – a text which deserves to be revisited more in the light of contemporary studies of emergence.

Fundamentally, both the Ratio Club and Macy Group were preoccupied with the question "what is mind?" In other words, how do systems self-organise, and self-assign goals, etc. In the years that followed, most of the main participants would publish extensively on the subject. Gregory Bateson for example published his collected essays *Steps to an Ecology of Mind*, as well as his book on *Mind and Nature*; Warren McCulloch published his collection *Embodiments of Mind*; Ross Ashby published *Designs for a Brain*; Heinz von Foerster published *Understanding Understanding: Cybernetics and Cognition*; and Grey Walter published *The Living Brain* – to list but a few. These pre-occupations would continue with the next generation of cyberneticians: Humberto Maturana and Francisco Varela would publish *Autopoiesis and Cognition*, Stafford Beer *The Brain of the Firm*, whilst Varela again, this time with Evan Thompson and Elanor Rosch, wrote *The Embodied Mind*.

Importantly, some of the key conceptions that emerged during this research – that mind was essentially an activity, a relational process or organisation, and not a separate thing – and that mind was immanent within, embodied with, material processes, and not limited in any simple way to traditional conceptions of self, are being replayed (and to a lesser extent, referenced) today in contemporary cognitive sciences and the various contemporary neo-vitalist and materialist theorisations. Many of these early texts remain an important resource for exploring new conceptions of ecological materialism and extended mind.

In Stuart Umpleby's historical account of the development of the field following the first period of cybernetic theory, there were three distinct discourses that emerged, not all of which continued to use the term "cybernetics". One strand developed out of the work of Alan Turing and John von Neumann, and led to computer science, artificial intelligence (AI), and robotics. The second strand arose out of Norbert Weiner's work on control mechanisms and systems, became a part of electrical engineering, and developed further

Feedback Systems

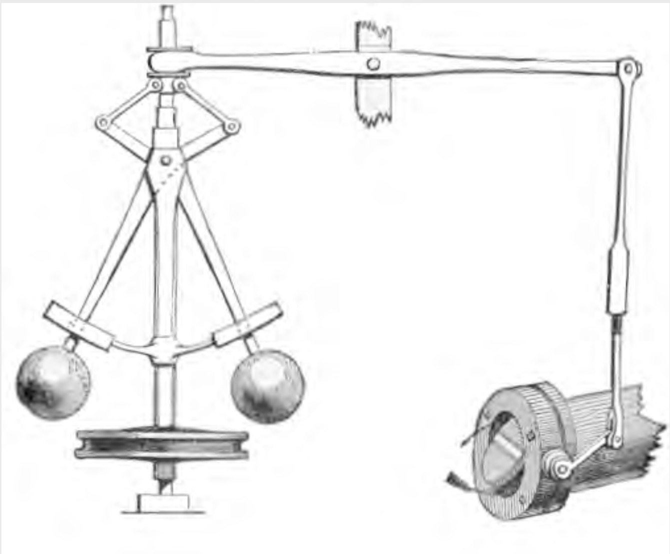
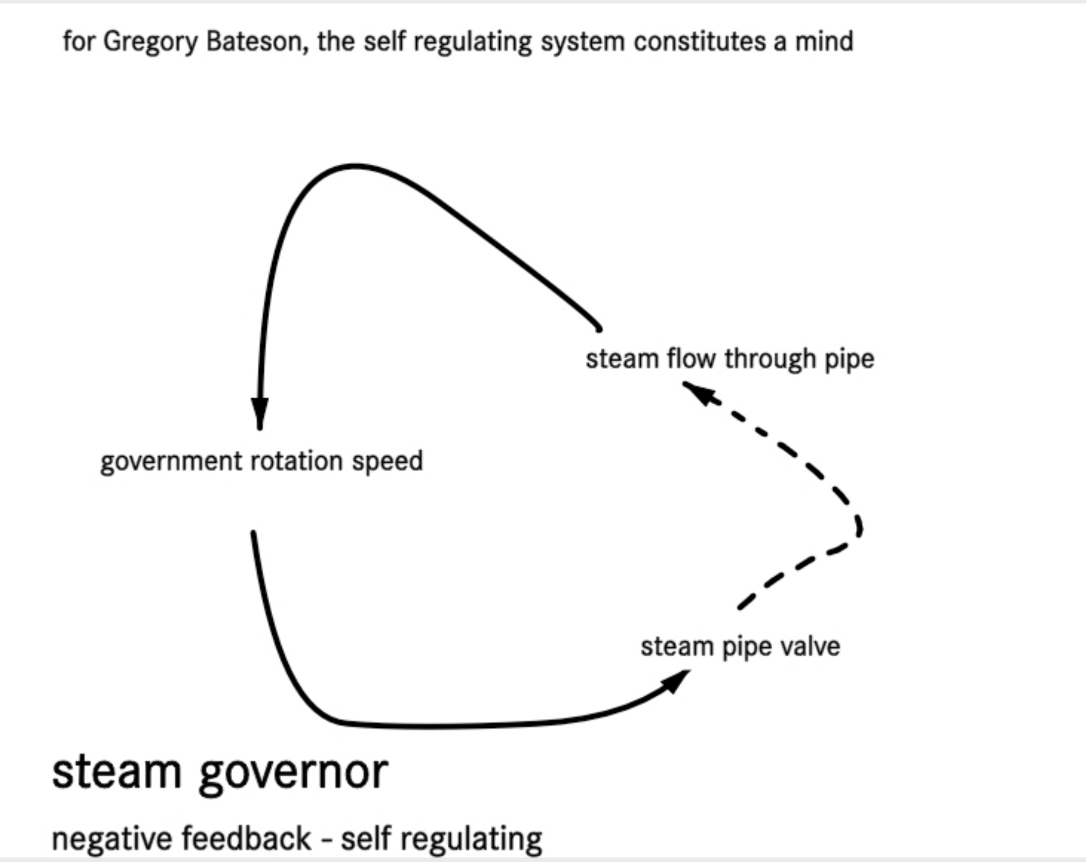


Fig. 4.21 and 4.22. The Watt Steam Governor is a classic example of a very simple self-corrective cybernetic feedback system – i.e. a negative feedback system. The faster steam flows through the main pipe, the faster the axle turns which centrifugally throws the ball weights out and up. This lifts a lever to close a valve in the pipe, thereby reducing the steam flow. This is the negative feedback, which means that the system exhibits homeostasis, and oscillates around an ideal value, like a boat constantly adjusting to maintain its course. A positive feedback system on the other hand feeds back upon itself in an amplifying circuit (such as audio feedback.) In Fig. 4.23, the Watt Steam Governor system is shown in the conventional language of cybernetic diagrams. A dashed line shows a negative loop segment. If drawn correctly, it is possible to add up the number of negative loop segments. If it is an odd number the system will be negative – i.e. it will reach and maintain a stable state. If there are an even number of negative segments, or none, then the systems will be positive, and will head off in an amplifying (or collapsing) direction.



into systems engineering. The third strand was grounded in Warren McCulloch's research into mind through the functioning of the brain and central nervous system (and I would add Gregory Bateson's studies of ecological and social systems as minds). Umpleby argues that of these three discourses it was only this third stream that maintained cybernetics as a fundamentally fluid and transdisciplinary field, whereas the other two simply became new applied disciplines. Thus it was primarily this third stream that developed into what became known as second-order cybernetics.

4.6 Key Concepts and Critiques that emerged from Macy Conferences

The Macy Conferences produced a series of important concepts and legacies. I would suggest that the most important new concepts, or new definitions of concepts, to emerge included:

1. Feedback[65]
2. Analogue and Digital[66]
3. Memory[67]
4. Neural Networks
5. Black Box [68]
6. Information[69]
7. Negentropy[70]
8. Difference[71]
9. Homeostasis and homeorhesis[72]
10. Law of Requisite Variety[73]

Consistently, the Macy meetings were concerned with understanding *how do networks of material relationships embody information?* They were working at a time when dualist models of mind and consciousness still had enormous influence, and they often struggled to find the language to describe both the essential monism or non-dualism of their project, and the paradoxical fact that their studies seemed to produce an almost Platonic world of information or *organisational relations* (i.e. they lacked, but also partially produced, moments of a dialectical relational conception of spacetime).[74] Participants wanted to understand how physical systems, through the organisation of their material parts, could

embody, form, produce and be affected by information. The material substrates that they were concerned with were very different. Mead and Bateson (and later Stafford Beer) were concerned with information flow in social groups and organisations. Bateson, Kubie and Lewin were interested in the flow of information in the psyche, and the emergence of "self". McCullough and Pitts were interested in the neuronal structures of organisms (they later notably wrote for example, with Maturana and Lettvin, a seminal paper on the brain and nervous system of the frog).[75] What united these different specialists was a process of *abstraction* – a joint concern with how, once whatever parts are organised into wholes (real or conceptual, concrete or abstract), their organisation gives rise to *new* behaviours, goals and information flows. Bateson in particular considered the epistemological and ontological *status* of "information", and it is useful I think to reflect upon the conditions under which cybernetic information might be considered in relation to Marxist conceptions of abstraction.[76]

Interestingly, whilst most delegates were abstracting *pattern* out of their *matter*, von Neumann and the "artificial intelligence" group were working with these abstractions and re-materialising them. Their work, combined with that of Ratio Club's Turing, directly resulted in modern information and communication technologies, and the digital computer.[77]

Discussing the legacy of the Macy events, Katherine Hayles has suggested that:

> ... the result of this breathtaking process was nothing less than a new way of looking at human beings ... Weiner did not intend to dismantle the liberal humanist subject ... he was following a train of thought that, since the Enlightenment, had argued that human beings could be trusted with freedom because they and the social structures that they devised operated as self-regulating mechanisms.[78]

As Hayles notes, cybernetics cannot help but question our definitions of the human, as "the idea of the feedback loop implies that the boundaries of the autonomous subject are up for grabs, since feedback loops can flow not only within the subject but between the subject and the environment."[79] Situated at (or above) the junction of a series of binaries – nature/culture, organic/technic, mind/matter – cybernetics was concerned with technology as both tool and organ, in the original sense of *organon*.

For several recent commentators such as Hayles, cybernetic research participated in the construction of a new dualism between material and information, or rather re-inscribed the old dualism between form and matter (or as I suggested previously, between pattern and matter), and so they feel it can be criticised in some way on that basis. Certainly, when Weiner stated that “information is information, not matter or energy. No materialism which does not admit this can survive in the present day,”[80] it is easy to see why such questions might emerge. But these attacks often seem to be based upon a misunderstanding of what is being asserted. Cybernetic research was based upon the proposition that the organisation that matter takes can only be understood through some kind of conception or abstraction of information, and that if reductive forms of analysis lose the information embodied as and within organised wholes, they lose something of their descriptive power. Pattern is in this sense simply a necessary abstraction from matter, a means by which we can understand the mental forms and organisations that are active within, and inform, matter. Still, in terms of the language that cybernetics develops, it is indeed the case that there is a privileging of terms like “pattern” and “mind” over “matter”. Processes of abstraction and pattern recognition did indeed tend by definition to foreground the information (i.e. the pattern) over actual matter. Whilst this process of abstraction is necessary, it is possible to “forget” that this is a process (and a fundamentally perceptual and epistemological process), and by doing so to inadvertently privilege pattern over matter. There are important dangers to be aware of when working with abstractions, and there are of course all kinds of reductive practices which can unwittingly embody all kinds of dominant social and political ideology, such as re-inscribing a familiar gendered dualism of relations.

Nonetheless, I am arguing in this thesis that a more sophisticated reading of cybernetics is not then that it takes “sides” in the matter/pattern binary, but rather that it goes some way to suspending and moves beyond it. In many ways, the attempt by cybernetic thought to grasp information as something like a real abstraction, and an effect of circular causality, might be understood as an attempt to reproduce Marxist dialectics, but without any revolutionary politics attached. Still, there are important distinctions between the cybernetic method and Marxian dialectics. For example, Bateson’s use of a process of abduction tends to start with the concrete and abstract out organisational

patterns, and connections between patterns. Whilst this is a materialist practice, it can tend to conclude (as a process) with conceptual abstraction, which can then perhaps lead to idealist or dualist tendencies. A dialectical materialist practice, by distinction, starts off by positing the kinds of abstractions that neo-cybernetics produces, but then ascends back up to the concrete. This is a very important moment in dialectical reason, as it tests the validity of the relations of any given abstraction by testing them in the real material world. In this sense, neo-cyberentic methodology might contribute as a moment of analysis at the beginning of a dialectical approach. Equally of course, cybernetic research from its earliest days was in fact constantly returning to concrete practice, whether in the McCullouch and colleagues studies of the workings of biological nervous systems as they developed theories of neural nets, the psychiatric and zoological work of Bateson, the material experiments of Pask, or the robotics experiments of Walter.

Indeed, in important ways, cybernetic research itself did tend to return to the concrete and produce *new real abstractions*, technologies that themselves seemed to promote an immaterialisation of (or simply obscured) all kinds of social relations. Indeed within the cybernetics group, and also within systems thinking more generally, two distinct tendencies emerged. For Bateson, most scientists and engineers were developing cybernetic insights into control and communication as dangerously instrumental technologies – to be used in what he saw as misguided attempts to control both natural and social systems. This would become for him a massive “epistemological” error, and was in many ways the real distinction between first-order and second-order cybernetics. This tendency was particularly problematic for him in the area of ecology, which he saw increasingly as a disciplinary enframing of nature – Bateson saw the danger as quantifying energy and matter, but missing the dimension of communication and mind, and thereby failing to grasp the insights of second-order thinking, which revealed, precisely, that it is not a straight forward matter to correctly understand or exert teleological control over a system from within that system.[81]

These processes of immaterialisation and instrumentalisation mirrored (but also instantiated and amplified) processes already underway within capitalism more broadly. As Hayles notes, “seeing the world as an interplay between informational patterns and material objects is a historically specific construction that emerged in the wake of World

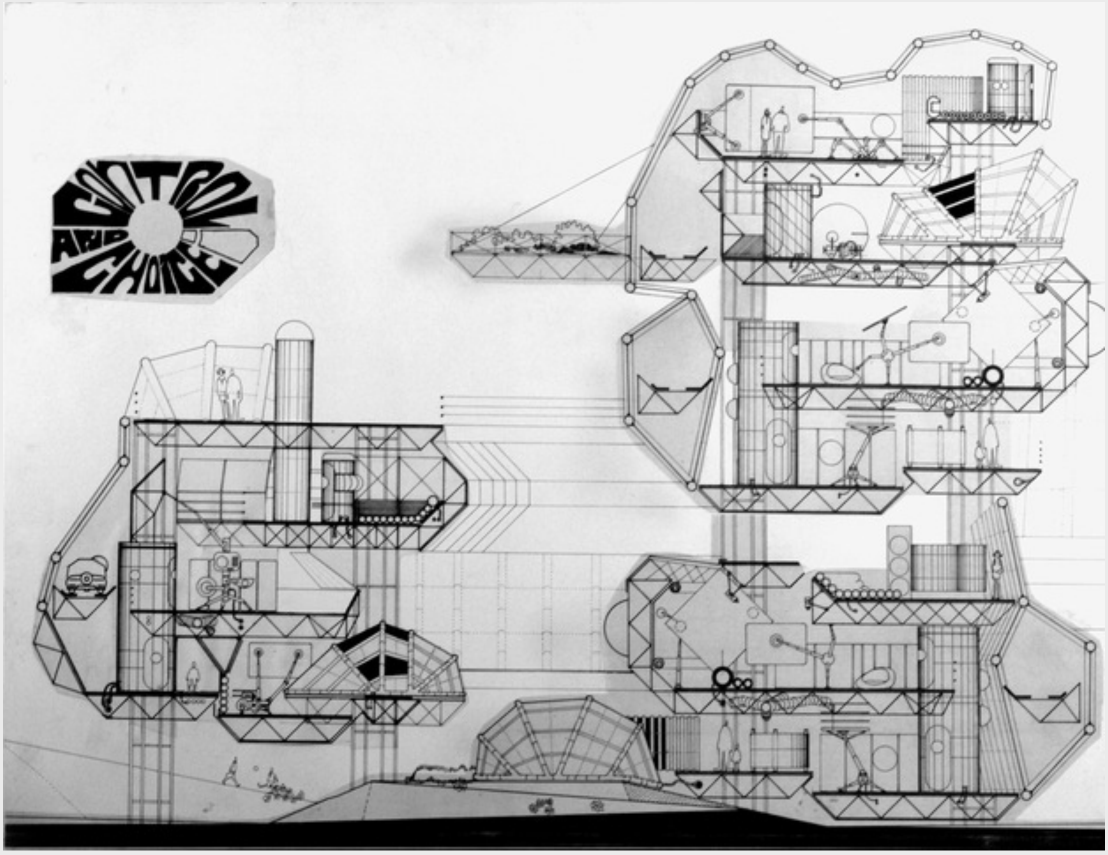


Fig. 4.24. Archigram, Control and Choice Dwelling, Section, 1967. Architectural, engineering and urban practice have of course been primary conduits for instrumental systems thinking. Equally, however, architecture has been a primary site for radical cybernetic experimentation: socially and technologically utopian speculation. Furthermore architecture schools provided a real academic enclave for radical cyberneticians such as Pask, as first-order systems theory became dominant and dispersed into AI, systems control etc and the few genuine independent cybernetic research projects were closed. To this day a strain of radical cybernetic practice has survived within some British architecture departments, often much to the surprise of systems thinkers based in other disciplines, who typically use the term “cybernetics” in a strictly historical sense.

Nonetheless, many seminal architectural projects that have a degree of what Pickering describes as “ontological theatre”, are ambiguously and inevitably in both camps. As Alan Colquhoun has noted, the flexibility and indeterminate programme of cybernetic environments can easily become “the occasion for the invention of a new type of bureaucrat - the ‘programmer’.”[151]

Jonathan Crary goes further in his criticism, arguing that the projects of Archigram “actually entailed the full subordination of the city’s inhabitants to the enormity of of their systems,” such that “once the city had been reduced to a kit of parts, only a humanist mirage could prevent its inhabitants from becoming one more relay in this new network.”[152]

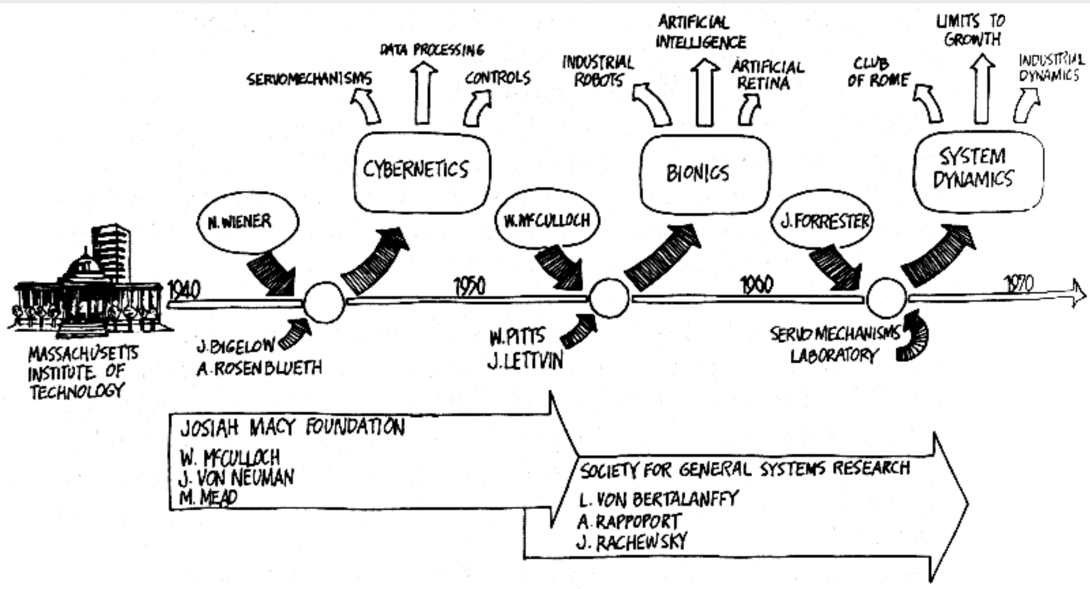
War Two."[82] It is impossible to divorce cybernetics from the social and cultural shifts that emerged with information and communication technologies, at both personal and economic scales. Things and relationships were increasingly *present* in immaterial forms that both undermined and supplemented the material base, not least of money itself, which was soon to be freed from its particular physical materialisation in gold reserves.

There are thus a series of distinct meanings associated with the word cybernetics. In addition to referring to a modern body of trans-disiplinary research into the immanence of mind within all kinds of material systems, it is also used to refer in general to the growth of informational technologies and systems that cybernetic research certainly helped to realise within capitalism. In addition, within the research itself there are very different kinds of practices. As Andrew Pickering has usefully emphasised, whilst there was a strand of cybernetics which proved all too easy for military-industrial capitalism to recuperate, there was also another, radical cybernetic tradition, composed of eccentric "nomadic scientists" (which for him is populated almost exclusively by the British contingent of Ashby, Bateson, Beer, Laing, Pask, and Walter), which passed through a re-conception of epistemology into a radical ontology – or what he calls the construction of an "ontological theatre" – in which "sketches of another future" were explored through the "conscious" experimentation in constructing "self".[83] These two tendencies – one radical, and one conservative – map approximately onto first-order and second-order cybernetics.[84]

This full range of associations of cybernetics was in some sense played out in a panel discussion involving Gregory Bateson, Meyer Schapiro, Rudolph Arnheim and Marcel Duchamp at the American Federation of Arts, entitled "The Creative Act", in April 1957.[85] In the discussion, the Marxist art critic, Schapiro, started off by opposing the extension of cybernetics into art, seeing it as a part of broader processes of rationalisation and instrumentalisation of the human under capitalism. Bateson (supported it seems by Duchamp, and this was not the first time they had shared a stage) argued that this is not necessarily what is at stake in such a question, but rather cybernetic thinking was bringing into question the whole condition of producing the human self within and as a part of a communicational network. Indeed, for Bateson, cybernetics and art have similar roles, both being concerned with communication – art for Bateson fundamentally being about

Systems Dynamics and the Club of Rome

Fig. 4.25. Several institutions might claim central roles in systems and cybernetic research (Heinz von Foerster's Biological Computing Lab at University of Illinois, or the Cybernetics department at Brunel), but few are as well founded as MIT – at least in some areas. In this interesting diagram the institute traces a direct relation between cybernetics and systems research, and the seminal environmental 1972 Club of Rome 'Limits to Growth' report. The later research of Jay Forrester and the Systems Dynamics group is particularly interesting, and controversial. Forrester and his group were amongst the first to use computers to model systems dynamics, and their focus was the analysis of human ecologies. They developed the first software aimed at this (SIMPLE (Simulation of Industrial Management Problems with Lots of Equations) and later DYNAMO (DYNAmic MOdels)), which was used in the production of the Industrial Dynamics report of 1961 (for General Electrics.) Forrester went on to collaborate with the former mayor of Boston John Collins on what became the Urban Dynamics model. Controversially, this model suggested that the construction of low income housing tended to produce low income enclaves of poverty. Most importantly, the Systems Dynamics group were commissioned by the Club of Rome to produce some dynamic global socio-economic resource flow models. Three models were made (WORLD1, 2 and 3). Famously and somewhat unexpectedly, all models predicted resource depletion/pollution based socio-economic collapse early in the 21st century, and the results were published in the seminal 'Limits to Growth' report in 1972.



meta-communication, or communication that is self-consciously about communication in some way.[86]

If then, it is important today to situate the development of post-war cybernetic thought historically, it is equally important to situate historically the 1990s critiques of cybernetics, as articulated by Hayles and others. In this sense, it seems to me that many of the assertions regarding the valorisation of information as a marginalisation of the body are overstated, if not simply confused; they themselves must be understood today within the context of the apparent immanent arrival of an immaterial world of “cyberspace” as it was being anticipated in the late-1990s. In fact, in the first decade of the twenty-first century, digital (or more accurately post-digital) culture has passed through what Malcolm McCullough has described as “the paradigm shift from building virtual worlds, towards embedding information technology into the ambient social complexities of the physical world.”[87]

Much of the “body theory” of the 1990s can thus appear a little naive today. Specifically, one should not assume that a simple return to the materiality of the body in cognition research would be in itself enough. Indeed we have seen, in the decade since Hayles wrote her key text, an enormous return to the body in many of the formulations of new materialism, and embodied and extended mind theory (which I will talk about in detail in the next chapter) – and indeed, in many contemporary attempts to formulate an architectural phenomenology. But what we see here, whilst being progressive and challenging in many aspects, is nonetheless often still based on a model of subjectivity that largely excludes any political formulation of the question of the production of subjectivity and consciousness, i.e. the mode of production of the extended mind, or of the extended mind as developed into a specifically *political* ecology.

There was of course always an implicit internal political ecology of cybernetics, broadly defined by the particular social, cultural and economic conditions in which it emerged. With regard to the Macy Conferences these conditions were complex. We might of course ask what were the repercussions of its situation within the military-industrial-entertainment complex. The relation of cybernetics’ research to the military is significant, and needs to be considered. It can equally, however, easily be overstated. The context did have definite effects upon the nature of the event and the research work that emerged.

Systems Dynamics

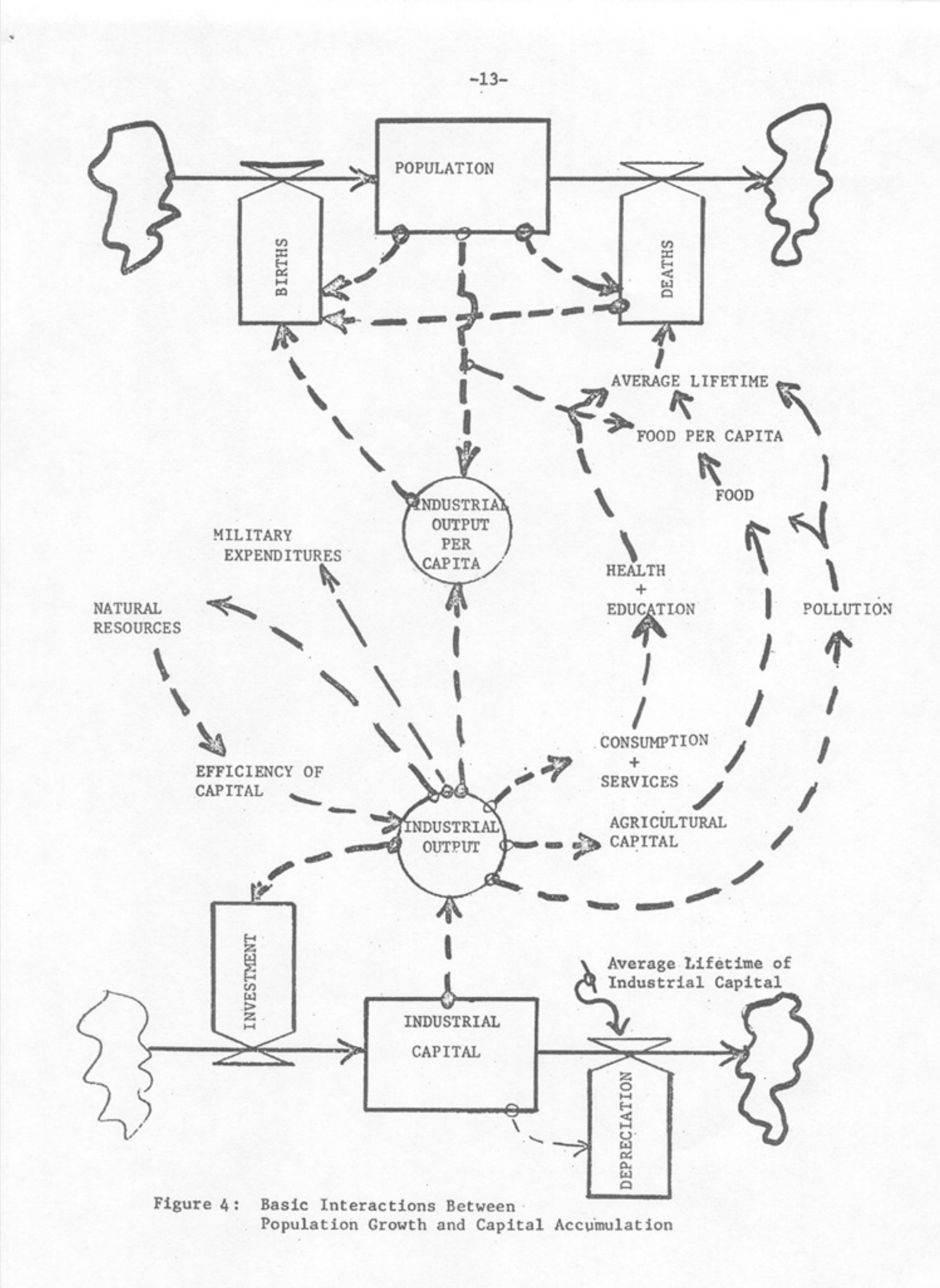


Fig. 4.26. Dennis L. Meadows, “Basic Interactions Between Population Growth and Capital Accumulation” from MIT-Club of Rome "Project on the Predicament of Mankind," 1972

Equally, this was a self-organised, cross-disciplinary attempt to work with what at that time still were some truly marginal ideas. When Stewart Brand asked Bateson and Mead whether cybernetics could have emerged without the Second World War, Bateson answered that Weiner's meeting with biologists was much more important.[88] Whilst of course it was inevitable that Bateson would emphasise the importance of biology, it is still important to note that the relationship of cybernetics to the forces of capitalism is not reducible to any simplistic relationship to the US military. The early cybernetics research was indeed supported by a complex mix of military-industrial funding, even whilst the work produced might be thought of as a mix of both "royal" and "nomadic" science (in Deleuze and Guattari's terms).[89] Certainly, as soon as it was possible to split off those first-order technologies of control, and to divide the knowledge into new disciplines, then the more nomadic and radically trans-disciplinary aspects of cybernetic thinking were quickly starved of research funding. It is today often lamented (somewhat uncritically) by second-order cyberneticians[90] that figures such as Marvin Minsky, and more generally the strand of cybernetic thinking that led to cognitive science and AI research based upon symbolic manipulation, took away all of the research money. Perhaps ultimately the most important point to consider regarding the political economy of the cognitive sciences that developed out of cybernetics research is that they represent a major *social* shift in thinking about mind – a social shift in that the technologies behind it and produced by it are *fundamental to production*. It hence genuinely represents a new stage in both the history of human ideas about nature, and also the history of human ideas about mind – in which as Varela, Thompson and Rosch note, "knowledge has become tangibly and inextricably linked to a technology that transforms the social practices which make that very knowledge possible."[91]

4.7 Second-Order Cybernetics

If the first wave of cybernetic research was focused around the role that feedback plays in creating *homeostasis*, the second wave focused on the role than feedback plays in creating *reflexivity*, which for Hayles is defined as "the movement whereby that which has

Paskian Conversations with Gaudi

Figure 4.27-32. A series of moments from Parc Güell, Barcelona, by Antonio Gaudi, built 1900-3.

Gordon Pask described the Parc Guell of Antonio Gaudi as “one of the most cybernetic structures in existence”.[148] Although perhaps initially surprising, in that one might have expected Pask to choose something more obviously dynamic and contemporary, upon further reflection his choice proves to be a sound one which can teach us something about both cybernetics and architecture.

There are no moving parts in the Parc Güell's built architecture. If we are to find cybernetic structures here, then we can be sure that they will not be located within mechanically/technologically activated components, in the way that say Pask and Cedric Price's Fun Palace was a cybernetic device that physically reconfigured its parts, or in the way that say an installation by Jason Bruges or Usman Haque might move or change its lighting according to a change in its environment or occupation. Pask notes that “Gaudi (intentionally or not) achieved a dialogue between his environment and its inhabitants. He did so using physically static structures (the dynamic processes depending upon the movement of people or shifts in their attention).”[149]

Rather, the cybernetic structures that Pask refers to here must be due to a system that comes into being when the Park is occupied by people. Pask notes that “as you explore the piece, statements are made in terms of releasers, your exploration is guided by specially contrived feedback, and variety (surprise value) is introduced at appropriate points to make you explore.”

been used to generate a system is made, through a changed perspective, to become part of the system it generates."[92]

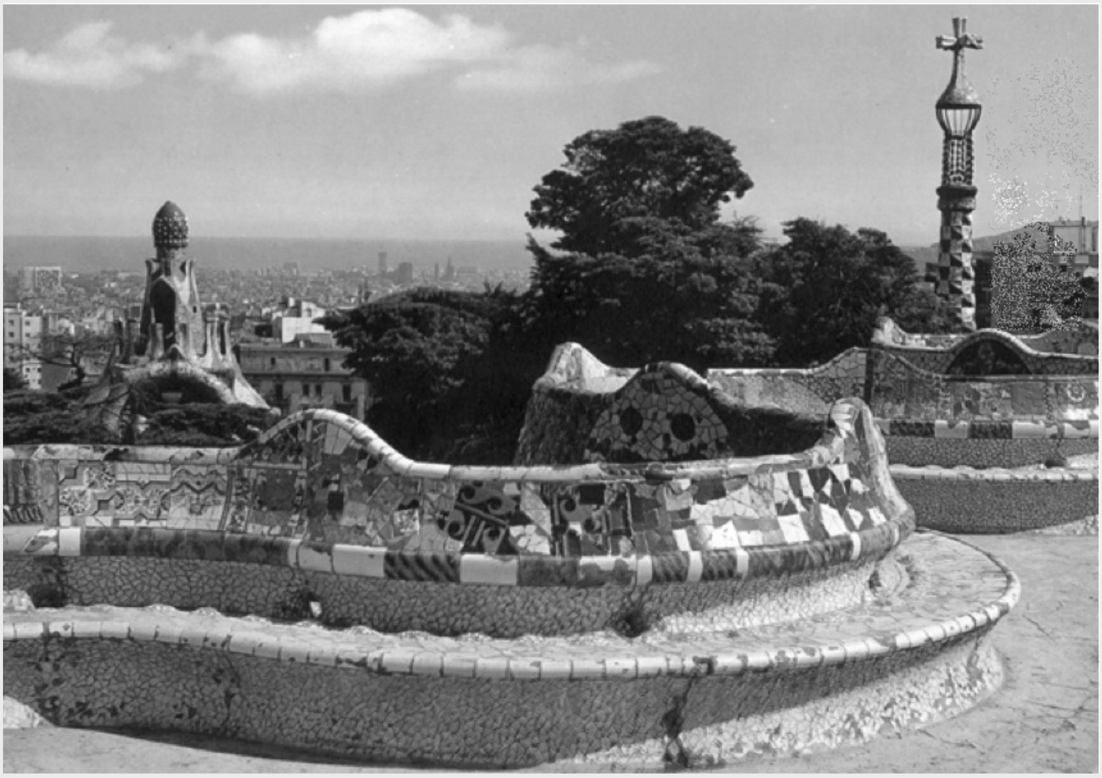
As Hayles herself recognises, many of the criticisms that she lays out as the her central thesis in her history of cybernetics[93] are often little more than embellished versions of criticisms that emerged within the Macy Conference group itself, around Margaret Mead, Heinz von Foerster, and in particular Gregory Bateson. As Peter Harries-Jones has observed:

> Bateson became the single most important reformer of cybernetics. He was the intellectual leader who most thoroughly and continually opposed its dominant face – that of determinism and control. The transformation of cybernetics from a science concerned with application of feedback as control towards a science concerned with applications of how society constructs its own models of change and stability, and then proceeds to hide those constructions in its rationalisations about social and ecological order, stands as one of Bateson's intellectual achievements.[94]

The questions that Bateson, Mead and von Foerster were asking would be returned to repeatedly in their work through the 1950s, 60s and 70s, and would re-coalesce to constitute what Pask later referred to as "New Cybernetics", and which is today increasingly referred to as neo-cybernetics. For these thinkers it was clear that for many of the real concrete systems being considered, the very act of observing the system had effects upon the system. This was very obviously true in quantum mechanical systems, or social/anthropological systems, or certain electrical circuits for example – but it was, they now argued, an unavoidable epistemological principle. As Ashby stated, "objectivity is the delusion that observation can be made without an observer."[95] Klaus Krippendorff also suggests:

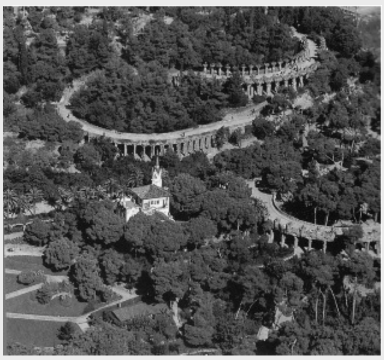
> ... the shift from a first-order to a second-order cybernetics signalled a shift in scientific attitude toward reality, from privileging the perspectives of detached observers, spectators or engineers of a world outside of themselves to acknowledging our own participation in the world we observe and construct as its constituents.[96]

Paskian Conversations with Gaudi



Broken ceramics have a complex proto-Dadaist communicational role: by incorporating fragments of the "everyday", reality denies representation, and "stands in" for itself). Forms such as flowing curves, which can be seen on roof lines and parapets, begin to rise up out of the ground, and come down from the roofs, to form "open enclosures": architectural frameworks that mediate between the shifting topography of the land and the moving body of the visitor. Stairs are immediately presented to the visitor, and are used as a way of introducing the feeling that this is an architecture to be climbed over, a playground. Parc Güell is an exemplary study in relational combinations of spatial archetypes: the basic ways that space can enclose and act upon the body: framing, elevation, enclosure, extension.

Pask notes, in relation to Gaudi's work in general that "it is interesting that Gaudi's work is often *contrasted* with functionalism. Systemically it *is* a functionalism pure and simple, though it is aimed at satisfying only the symbolic and informational needs of man."[150] In this essay, Pask notes the important congruences of what he calls "pure architecture" and systems theory, suggesting that architecture and cybernetics "share a common philosophy of architecture". His comments support my observation in chapter one that architecture is the "foundational" systems theory.



Second-order cybernetics as a term is generally accredited to a paper written by Margaret Mead, but one which von Foerster specifically commissioned, called “The Cybernetics of Cybernetics”. Mead drew upon her experience in anthropology, where she was amongst the first to recognise the active role that the anthropological observer always plays in the social group being observed. As Alan Watts was to point out “from physics to psychology, every department of science is realising more and more that to observe the world is to participate in it, and that, frustrating as this may first seem to be, it is the most important clue of all to further knowledge.”[97] Just as important as the recognition of the active observer was the other sense in which there was shift towards reflexivity: i.e. in the kind of systems that were under consideration. Whereas first-order cybernetics dealt primarily with controlled and relatively closed systems, second-order cybernetics deals with autonomous and more open systems, and in particular neo-cybernentics is concerned with understanding systems that can define their own goals.

There are several strands of second-order cybernetic thinking that have been developed since the days of the Macy group. In the UK the trajectory set out by von Foerster in particular has fed into architectural discourse. This lineage includes notably Gordon Pask, Cedric Price, John Frazer and Ranulph Glanville, and later figures like Pete Silver and Stephen Gage. Glanville’s research has focused mainly on the question of teaching and learning as a cybernetic system: he considers the process of design to be a second-order cybernetic loop, suggesting that “the designer is the observer in circuit.” Much of this is a development and application of Gordon Pask’s work on *Conversation Theory* and *Interaction of Actors Theory*.[98] For Glanville, design is interesting as it allows you to participate in two roles at the same time: as the drawer and the observer. Drawing therefore allows you to have a conversation with yourself. The senses, as Marx once said, become theoreticians through their own practice.

4.8 Gregory Bateson: Patterns that connect ecologies of mind

In retrospect, probably, the most interesting figure to emerge from the Macy events, and the various second-order discourses that followed, was Gregory Bateson, in whom all the potential and dilemmas of ecological thought in its broadest sense were played out.

William Bateson and Chladni Figures

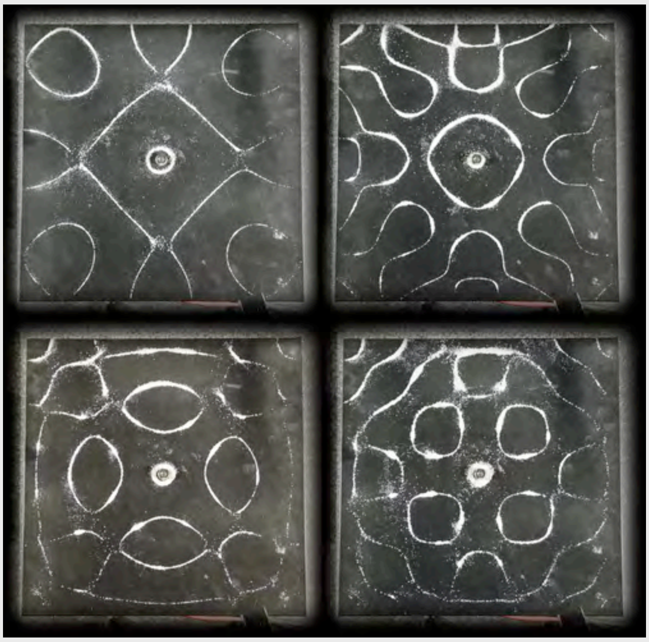
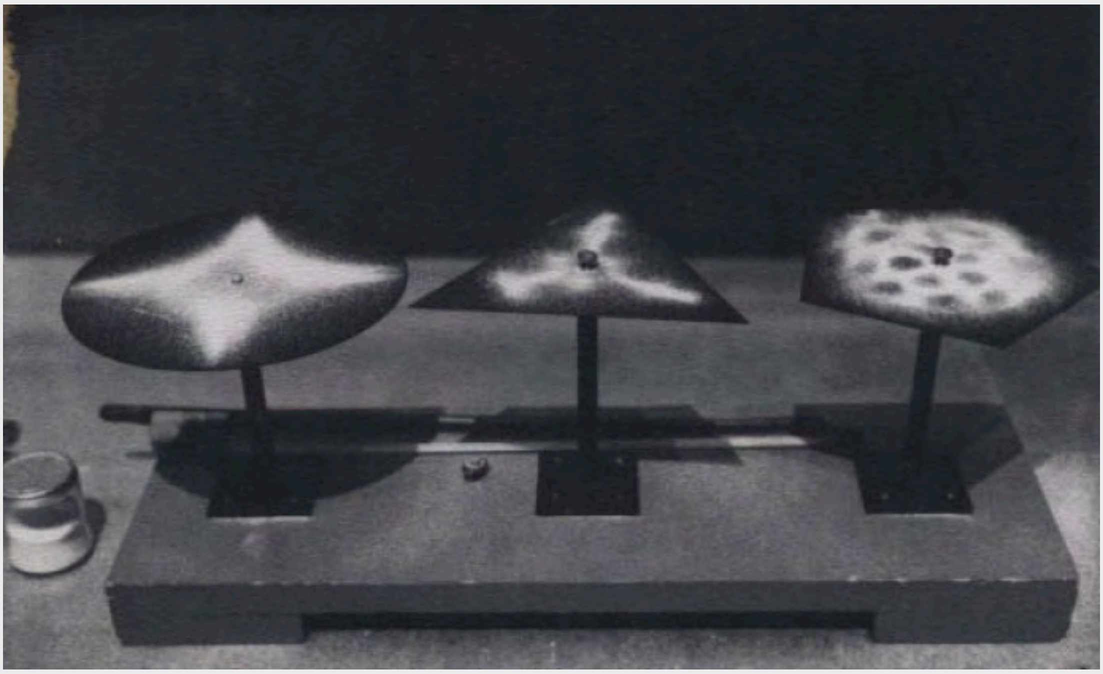


Fig. 4.33 William Bateson aka WB (1861-1926) – the father of modern genetics
Fig. 4.34 and 4.35. Chladni Figures, produced by using sound to vibrate a plate upon which sand or other fine grained particles resonate. For William Bateson, Chladni Figures provided a metaphor for understanding organic form, and he speculated about how “resonance” might work in organismic morphogenesis. Rupert Sheldrake’s hypothesis of causative formation seems to rely upon a related conception of ‘morphic resonance’.

To be sure, Chladni Figures are a great means of grasping whole/part systems relations. Sanford Kwinter has in a recent paper used these figures in relation to the Deleuzian conception of the “virtual”. He suggests that in any given resonant pattern, the particles will tend towards an ideal form, which we can visualise, even though in any given instance the materialised pattern will be “imperfect”. He suggests that the ideal form that “underlies” any given instantiation of “the actual”, is “the virtual”, he states that “both the actual and the virtual structures are legible in the same image, though their ontological status remains perfectly distinct.”[153]

These resonant patterns have also provided the basis for a range of holistc and sometimes mystical accounts of life, the universe, and everything, such as in Harmonic Resonance Theory.



Bateson moved through an extraordinary range of disciplines in his colourful career. Starting in biology, he later made important contributions to anthropology, psychiatry, ecology, aesthetics and media studies, and of course cybernetics and systems thinking in general. Adopted as something of a guru by the counter-culture in the 1960s, Bateson can properly be described, as Andrew Pickering has usefully suggested, as practising something approaching a free-thinking nomadic science, in the sense that Deleuze and Guattari referred to. Bateson himself bemoaned the difficulty of finding regular work as what he called a “freelance epistemologist!”

Born in Grantchester, England, in 1904, Gregory Bateson was the youngest son of William Bateson, who himself was an important Victorian/Edwardian geneticist and biologist. In fact, WB (as the father was referred to) coined the term “genetics”, and following the rediscovery of the work of Gregor Mendel in 1900, he became one of the first to recognise the importance of Mendel’s work on hereditary traits as passed through the cross-breeding of peas. The elder Bateson was broadly interested in a holistic approach to science, and considered how phenomena such as chladni figures (resonant patterns) might facilitate an understanding of whole/part relations in living organisms. William Bateson was closely associated with Alfred North Whitehead, both philosophically and personally, and was at heart a relational-process-based thinker.[99]

Notably, William Bateson would challenge the dominant Darwinian interpretation of evolution as a gradual process, instead focusing on explaining the many discontinuous jumps through the study (teratology) of animal and plant symmetry and metamerism (i.e. mutations).[100]In a fascinating book, *Materials for the Study of Variation: Treated with special regard to Discontinuity in the Origin of Species*, the elder Bateson drew together a wide range of ‘monstrous’ specimens from museum collections the world over that had tended to be ignored or marginalised. Discussing this part of his father’s work, Gregory Bateson notes that whilst:

> ... it is difficult today to define precisely what it was that he was after… it is clear that he believed that an entirely new concept of the nature of living things would develop from the study of such phenomena. He held that ... natural selection could not be the only determinant of evolutionary change and that the genesis of variation could

Information and Symmetry Breaking

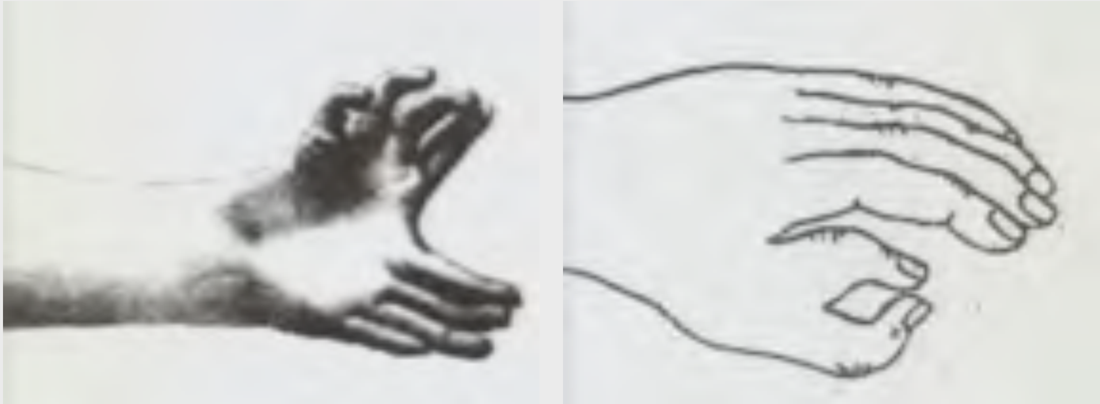
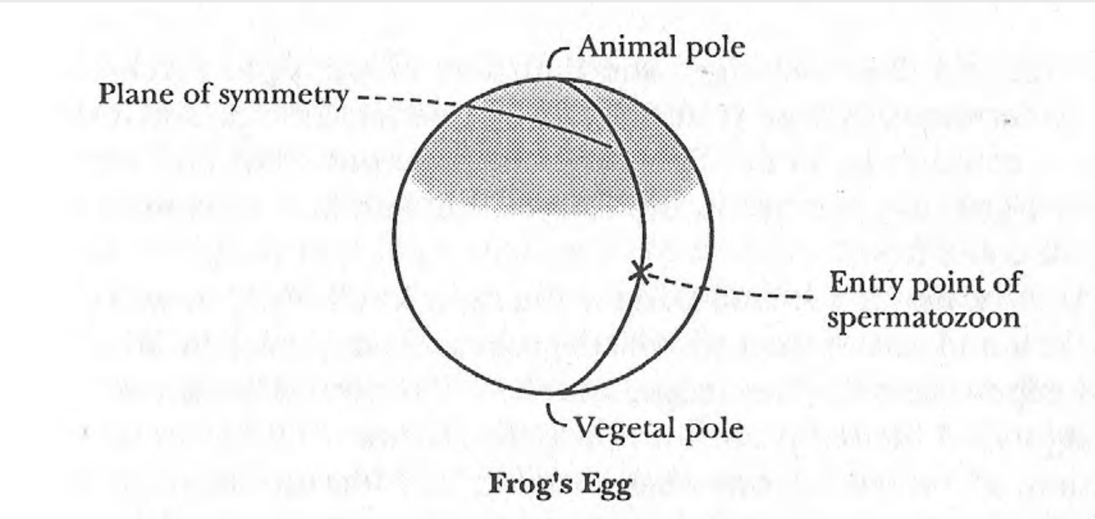


Fig. 4.36 and 4.37. In *Materials for the Study of Variation – Treated with special regard to Discontinuity in the Origin of Species* (1898), William Bateson took a wide variety of metameric examples, looking for what Gregory Bateson would later describe as 'patterns that connect.'
Fig. 4.38 Whereas the older Bateson suggested a resonant field explanation, Gregory Bateson revisited the material in the light of a cybernetic-information theory approach. He would theorise the patterns of *increasing* symmetry as *a loss of information* – or to put it another way, he would define symmetry breaking as the introduction of new information. In papers such as 'The Thing of it Is', Gregory Bateson described embryological morphogenesis as a dialectic of symmetry and difference. He uses as one example the frog's egg. Here the egg is waiting for information to start cell division. This information is provided by the entry point of the sperm. This process can be initiated in the frog's egg by simply puncturing the egg with a fine point, such as a horse hair. The egg will start division, the initial plane of symmetry having thereby been defined, and this will go on to produce a living organism – although this being will not itself be able to reproduce, as it will be missing half of its genetic code.



> not be a random matter. He therefore set out to demonstrate regularity and lawfulness among the phenomena of variability.[101]

In particular, William Bateson demonstrated that mutations frequently contain more symmetry than the norm, and developed the beginning of a conception of genetic information as symmetry breaking. This became known as “Bateson’s Rule”.[102] Gregory Bateson did in fact return to consider this work by his father, and was able to resolve a series of what had been, until then, biological anomalies, in light of his own cybernetic conception of information flows and patterns of difference.[103]

William Bateson is thus of note to us here, simply because much of Gregory Bateson’s work ultimately explored the same non-conformist concerns about evolution and information. More than that, the concern with aesthetics as a mode of “second-order science” can be traced back to the father in several respects – most importantly through a shared interest in William Blake’s passionate critique of Newtonian science (see Fig. 4.46).

Gregory Bateson first read natural science and later anthropology at Cambridge University in the 1920s. From 1927-30 he was engaged in anthropological fieldwork with the Iatmul tribe in New Guinea, where he first met Margaret Mead. Mead herself, as previously noted, would go on to become one of the most important anthropologists of the twentieth century, as well as playing a key role in the development of cybernetics. Bateson then returned to Cambridge as a research fellow for seven years, and wrote up his anthropological research as *Naven*, which was published in 1936. The same year he returned to anthropological field work with Mead – they were now married – but this time in Bali for two years. In 1939 they had a daughter, Mary Catherine Bateson, who would herself play an important role in the development of cybernetics and environmentalism.

Much of Bateson’s early anthropological work concerned studies of how learning occurs within individuals and groups. This required a study of the complex and multiple levels of communication that operate in such scenarios. He was concerned with how to understand and represent information flows – and the interactions of information flows – within social groups at various levels of meaning (myth, ritual, daily life). Clearly, Bateson

The Cybernetics of Cybernetics

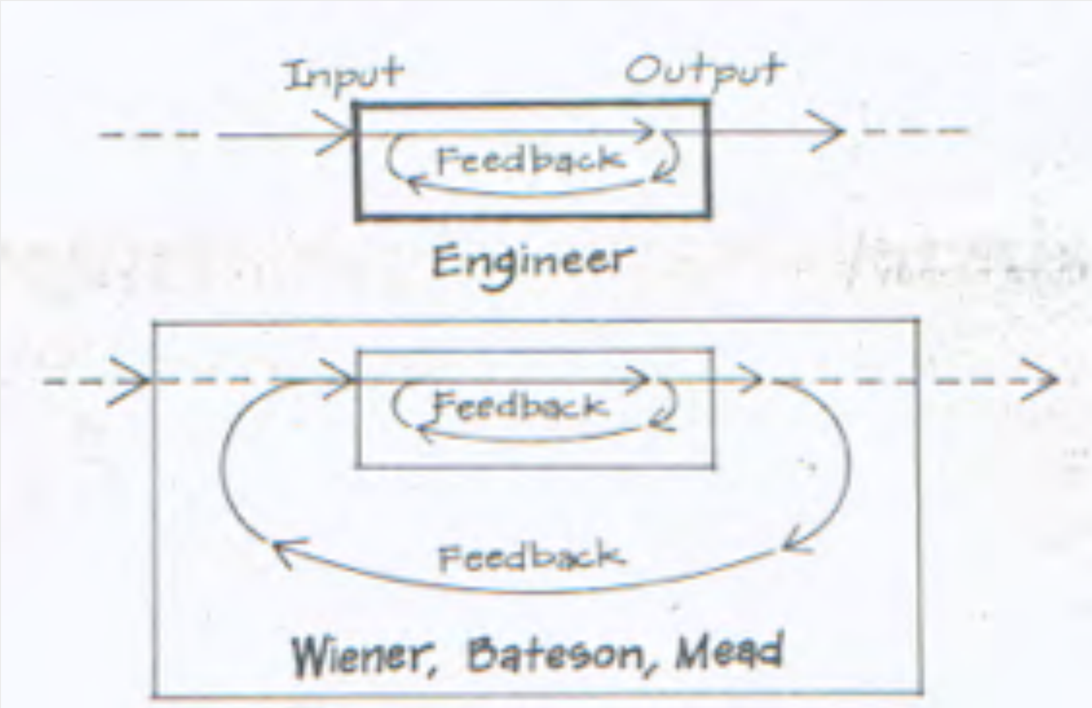


Fig. 4.39 Diagram drawn by Gregory Bateson to show the difference between first-order and second-order cybernetics, in conversation between Stewart Brand, Gregory Bateson and Margaret Mead.

and Mead's work had all kinds of relations with the contemporaneous development of structuralist anthropology by Claude Levi-Strauss in France.

In his anthropological work, Bateson considered human societies as analogous to organisms in themselves, with groups typically maintaining homeostasis through self-regulation. He also described how certain social information flows would lead away from equilibrium, resulting in splits and the formation of new groups. These socio-informational processes were quite analogous, he noted, to the bio-informational processes of cell division in embryological development.

In this early work, Bateson and Mead were already beginning to develop concepts that would prove critical to the development of post-war cybernetics. In Bali, Bateson focused on using photography and film as a means of identifying patterns of behaviour, in one of the first critical uses of modern media in anthropology.[104] Importantly, Bateson had by this time developed a proto-cybernetic notion of feedback in his analysis of Balinese social systems and rituals, through his dialectical conception of *schismogenesis*. Most importantly, both Bateson and Mead were reflecting deeply upon the status of the field anthropologist, especially the fact that as observers they are inevitably interfering with that which they observed. However, their response was not to ignore this problem, nor to try to marginalise it. Rather, they recognise the need to theorise their practice, to work with the participatory feedback effects of their observing, as a form of interface. Bateson's innovative use of the medium of photography and film was key to this process, and was self-consciously theorised as such in Bateson and Mead's book on *Balinese Character*. Their conceptualisation of the observer's participation in the system being observed would later, as noted, become a key insight of second-order cybernetics, and resonated with similar – and almost aesthetic – "discoveries" in both the natural and social sciences.[105]

In a sense, already by this period Bateson had redrawn the boundary between different sciences, as well as between the sciences and humanities. Conventionally in western thought, we tend to think of a clear distinction between the natural sciences and the social sciences, albeit that all kinds of contemporary discourses – including Latour's actor-network theory, Thrift's nonrepresentational theory, and various strands of Marxian theory, not to mention the very processes of contemporary capital – are today once again critically rethinking and challenging boundaries between the sciences and humanities.

Fig. 4.40 Gregory Bateson and Margaret Mead in the mosquito room at Tambunan, Bali in 1938.

Fig. 4.41. Bateson (bottom left) at the ‘Western Round Table on Modern Art’, San Fransisco, California, in April 1949. George Boas is at the head of the table, Frank Lloyd Wright next to him, and Marcel Duchamp is two down.

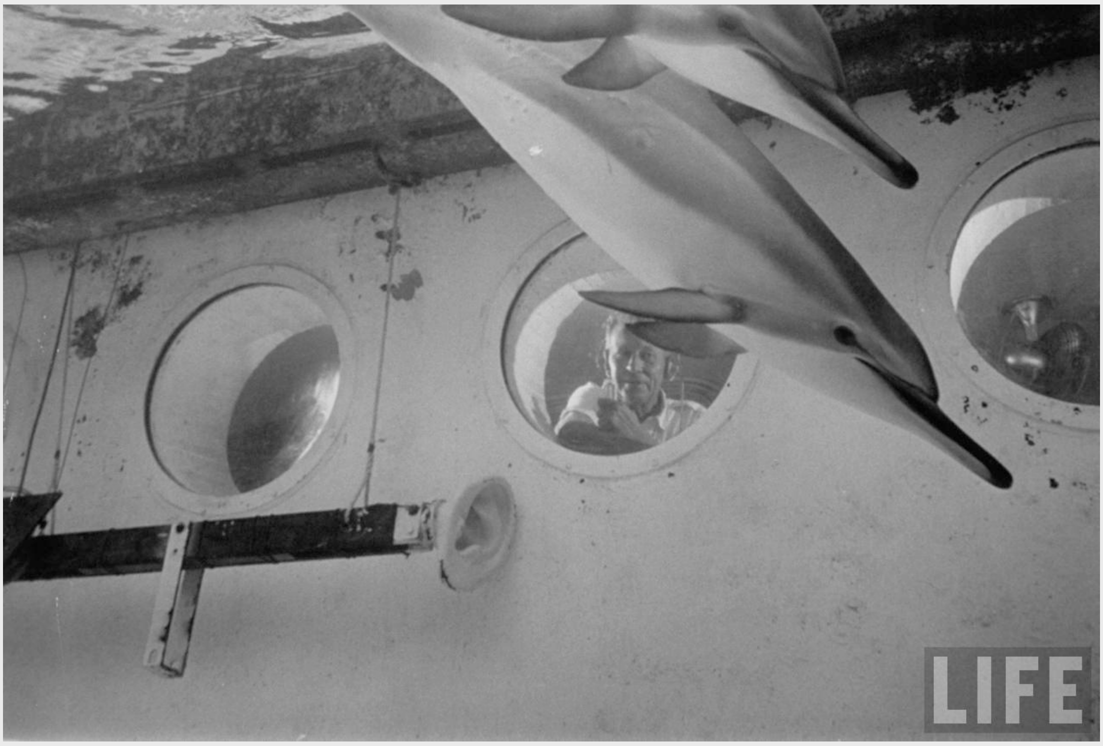
Still, as famously bemoaned by C. P. Snow in his 1959 book on *The Two Cultures*, our dominant conception is that physics, chemistry and biology etc form the natural sciences, we then think of the social sciences as entirely distinct, producing a very different kind of knowledge. For Bateson there was a very different distinction to make, which was between living systems and non-living systems – or more specifically, between systems that organise themselves according to responses to differences, and those which do not. Living systems for Bateson would of course include organisms and ecosystems, but importantly would also include human social systems, such as families, social groups, and indeed cities. For Bateson, these differential systems cannot be properly comprehended through the quantification of mechanical categories such as mass and energy. Living systems are complex differential systems, and hence need to be understood through pattern and information flow, he argued. Living systems are always primarily communicational in character: they are semiotic material processes. For Bateson, therefore, it was entirely proper to think of human social systems and natural systems as essentially related, and perhaps fundamentally different in kind to non-living systems.[106]

These early years are often glossed over in accounts of Gregory Bateson's influence on cybernetics, but are of crucial importance to the development of his thinking. Bateson critique of the dualisms at the heart of western epistemology starts in this initial period. He was clearly struggling with ways to go beyond the limits of mechanical materialism or the problems of supernatural idealism. In his attempt to get beyond the dualism of mind and matter, nature and culture, Bateson shares much with the dialectical techniques of Hegel and Marx, and indeed he has been described, not inaccurately, as an "Hegelian Ecologist".

Gregory Bateson was of course a British citizen, and with the outbreak of hostilities in 1939 he was sent to the USA, apparently with the remit of building support amongst American intellectuals for their country to enter the war. While over there, Bateson had a variety of jobs, including working for what would become the Institute of Intercultural Studies (later led by Margaret Mead, and then Mary Catherine Bateson, before it finally ceased activity in 2009), and also working at the Museum of Modern Art in New York as a film analyst. Crucially, he was in New York in 1942 for the first Macy Group meeting entitled "Cerebral Inhibition", which is where he first met Warren McCulloch.

Fig. 4.42 Wonko the Sane (aka John Lilly - see footnote 110) and Burgess Meredith (sitting) – on board a dolphin interface machine; note the underwater organ keyboard behind Lilly's head!

Fig. 4.43 Gregory Bateson looks out his port window at Sea Life Park, 1965.



After the Macy Conferences, Bateson went on what was by any standards an extraordinary intellectual journey. He had a canonical impact within psychiatry, making important contributions to theorising the role that communication and informational systems play in processes as varied as family, self, and learning.[107] Notably, he mentored Richard Bandler and John Grinder whilst they founded neuro-linguistic programming (NLP), and as the leader of the Palo Alto Group, he formulated the concept of “double-bind” as a critique and extension of Ludwig Wittgenstein’s and Bertrand Russell’s Theory of Logical Types.[108] Bateson would go on to document experiments with LSD,[109] and along with John Lilly[110] he studied learning and communication in dolphins.[111] He would later turn to a consideration of all biological processes as being essentially epistemological structures.[112] For Bateson, the common aspect to all his research was the study of how communication and learning works – and notably, fails – in organised systems and networks, whether personal, social, material or ecological. Through his distinctive analysis of the human subjectivity and sense of self as the (frequently pathological)[113] product of a network of mental fields or communication ecologies, both natural and artificial, within and beyond the individual organism, he became an important influence on a generation of artists and intellectuals.[114] Although I will consider Bateson’s ecological conception of mental processes further in the next chapter, suffice it to say here that he argued that mental process is a property that is ubiquitous in organised material systems – and in particular those systems organised to such a degree that we define them as living. Regarding the nexus of mental processes that define human subjectivity, he stated that:

> ... the total self-corrective unit which processes information, or as I say, ‘thinks’, ‘acts’ and ‘decides’, is a *system* whose boundaries do not at all coincide with the boundaries either of the body or of what is popularly called the ‘self’ or ‘consciousness’.[115]

Bateson became increasingly engaged with the question of environmental degradation, and as such was adopted by many in the 1960s counter-culture movement as an icon and leader. He was always careful to distance himself from both the more nostalgic and the more politically radical forms aspects of the counter-culture.

Nonetheless, like others – notably Stafford Beer, Ross Ashby, Ronnie Lang, Alan Watts, Francisco Varela and Evan Thompson – Bateson became increasingly fascinated by the similarities between Buddhist and cybernetic conceptions of mind. He spent his final years at the Esalen Institute in Big Sur, California, and died in 1980 at the Zen Centre there.[116] Describing his relationship to the broader counter-culture movement, Bateson stated that

> I have, after all, chosen to live at Esalen, in the midst of the counterculture, with its incantations, its astrological searching for truth, its divination by yarrow root, its herbal medicines, its diets, its yoga, and all the rest. My friends here love me and I love them, and I discover more and more that I cannot live anywhere else. I am appalled by my scientific colleagues, and while I disbelieve almost everything that is believed by the counterculture, I find it more comfortable to live with that disbelief than with the dehumanising disgust and horror that conventional occidental themes and ways of life inspire in me. They are so successful and their beliefs are so heartless.[117]

Bateson's entire career might in a sense be understood as a personal double-bind relationship with science, which he insisted – anticipating later social constructivist and actor-network positions – had to transform the way it conceived of its performed and produced knowledge: "the point is that the ways of nineteenth century thinking are becoming rapidly bankrupt, and new ways are growing out of cybernetics, systems theory, ecology, meditation, psychoanalysis, and psychedelic experience."[118] Ultimately, as Sergio Manghi has argued:

> ... the 'ecological' language created by Bateson, in particular starting in the 1960s, has to be considered one of the most important attempts of the 20th century to rethink the human condition in the planetary era. It was … an attempt to explore in depth our being part of larger systems – interpersonal, social and natural ...[119]

As Verena Andermatt Conley has also noted, "Bateson exercised a decisive influence on many French thinkers of 1968,"[120] and in particular his concept of the "double-bind" has had an important afterlife in post-structuralist philosophy, notably in the work of Jaques Derrida, Giles Deleuze and Felix Guattari. For Derrida, Bateson's conception of the "double-bind" and "difference" would be influential, and indeed it could be said that

following Bateson's communications-based description of the totality of living systems, there is nothing outside of the text.

Bateson used the concept of the "double-bind" to develop an important theory of schizophrenia, as both an individual and a social condition. He argued that these conditions were not clinical (and therefore unsuitable for the pharmacological, surgical and electrical treatments that dominated psychiatry in that period), but were rather based in the ecology of external and internal relationships that constitute selves:

> ... what I am suggesting is that the process whereby double binds and other traumas teach us a false epistemology is already well advanced in most occidentals and perhaps most Orientals, and that those whom we call schizophrenics are those in whom the endless kicking against the pricks has become intolerable.[121]

Bateson's work on schizophrenia was taken up by R.D. Laing in particular, and became a key part of the anti-psychiatry movement. Giles Deleuze and Felix Guattari have acknowledged the importance of Bateson's work in the formation of their project in *Anti-Oeidipus* and *Mille Plateaux*. As well as being hugely indebted to Bateson's exploration of schizophrenia – "In short, *the 'double-bind' is none other than the whole of Oeidipus* [their italics]"[122] – they also named their seminal book *Mille Plateaux* after Bateson's use of the term:

> Gregory Bateson uses the word 'plateau' to designate something very special: a continuous, self-vibrating region of intensities whose development avoids any orientation towards a culmination point or external end.[123]

More than that, though, it is fairly clear that the entire conception of a rhizomatic ecology of flows between desiring machines and social machines that characterises Deleuze and Guattari's account owes much to Bateson's imagination. And of course, Guattari drew heavily upon Bateson's "ecology of mind" in his book, *The Three Ecologies*.

It became increasingly clear to Bateson that it was a particular conception of mind as a description of communicative processes in material systems that characterised the broad locus of his research, whether he was working with social formations in Bali, or

cybernetics at the Macy Conferences, or family and individual therapy in Palo Alto, or dolphins in Hawaii, or the environmental question in general. He noted that:

> I do not need schizophrenic patients or unhappy families to give my thinking empirical roots. I can use art, poetry or porpoises or the cultures of New Guinea or Manhattan, or my own dreams or the comparative anatomy of flowering plants. [124]

Bateson’s conception of mind had much to say specifically about the human social condition, but was much broader than that, in that it equated cognition – as Humberto Maturana and Francisco Varela would soon after repeat in defining the project of their Santiago School – with the most fundamental processes of living systems.[125] Throughout this period, Bateson continuously reflected upon lessons from his various research practices in relation to the profound epistemological challenges to the “linear” formal logic of western thought that were raised by the circular – and later more complex and recursive – causality of cybernetics . Bateson drew upon an increasing number of logical models to work with and theorise ecological systems of various kinds. For much of his career he was strongly grounded in various forms of set theory. Notably, his “double-bind” theories were based in his adaptations of the set theory and typological hierarchies of Whitehead and Russell’s earlier theory of logical types. He also worked with Ross Ashby’s related theory of step changes (as in the “steps” in *Steps to an Ecology of Mind*). Bateson increasingly shifted away from circuit based analysis towards field based models, and thus from set theory to group theory.[126] In this way, he shifted his intellectual concern from circularity to the notion of recursion, noting for example that:

> ... it appears that the idea of ‘logical typing’ when transplanted from the abstract realms inhabited by mathematicological philosophers to the hurly-burly of organisms, takes on a very different appearance. Instead of a hierarchy of classes, we face a hierarchy of orders of recursiveness.[127]

Here he worked notably with the epigentic landscape mathematics of his lifelong colleague, Charles Waddington (a Marxian-Whiteheadian biologist), and the related Catastrophe Theory of Réne Thom. As the idea of recursion became more important to Bateson, he worked with another colleague, George Spencer Brown, who wrote *Laws of*

Form. Francisco Varela's new work became an important influence in his final years, in particular Varela's dialectical "3 part star calculus".[128]

Drawing upon all of these inputs, Bateson developed what he described as an ecological theory of mind. In this theory, he defined mind – or more accurately, mental process – through six criteria.[129] He stated that if all criteria are met, "I shall unhesitatingly say that the aggregate is a mind, and shall expect that, if I am to understand the aggregate, I shall need different sorts of explanations from those which would suffice to explain the smallest parts."[130] Bateson was clear in this statement that the key defining characteristic of mental process is that it exhibits something closely related to what we would today call emergence[131] – that is to say, that the organised "whole" exhibits new properties of its own. Importantly, for Bateson the new whole is of a *different logical type* in relation to the parts considered in isolation.[132] Bateson's definition of mind is such that it specifically includes processes such as embryological morphogenesis[133] and evolution[134] as mental processes, in that they are based upon structured responses to differences. In fact he states that "thought, evolution, ecology, life, learning occur only in systems that satisfy these criteria."[135] Bateson's description of natural, social and personal systems as phenomena that share organisational and epistemological structures, which needed to be thought of as being mental in character, was a distinct and proto-dialectical solution to the problem of emergence, based upon a pattern of internal relations, and a relational conception of space and time – and thus it has much to bring to the issues raised in the first chapter.

Bateson never engaged with Karl Marx's thought in any sustained theoretical sense.[136] There is however a distinct pattern which connects these two thinkers. Both were fundamentally grounded in a philosophy of internal relations. Both saw consciousness as a phenomenon that frequently and dangerously obscures its own conditions of emergence. And both interpret the modern conceptual division between nature and culture as a particular form of false consciousness. As Jesper Hoffmeyer has argued:

> ... as soon as we accept the reality of … relative being, we also immediately see the significance of Bateson's lifelong attempt to determine the pattern that connects ...

> nature and culture. Semiosis is constitutive to both of these realms, evolution and thinking are made up of the same stuff, and the name for this stuff is relative being.[137]

In some sense a link between Bateson and Marx was clearly established in Deleuze and Guattari's intellectual project, which as noted arguably took a number of Bateson's ideas (in particular concerning the dual personal/cultural character of schizophrenia) and combined them with Marxian thinking, relating the emergence of the schizophrenic condition to the growth of capitalism specifically (and the various systems and processes associated with it). However, Deleuze and Guattari suggest that Bateson failed to really leave behind his role as a *bourgeois* scientist, which meant that Bateson's work, and practice, would always be susceptible to recuperation[138] by what they refer to as Integrated World Capitalism (IWC):

> ... the scientist as such has no revolutionary potential; he is the first integrated agent of integration, a refuge for bad conscience, and the forced destroyer of his own creativity ... Gregory Bateson begins by fleeing the civilised world, by becoming an ethnologist and following the primitive codes and savage blows; then he turns in the direction of flows that are more and more decoded, those of schizophrenia, from which he extracts an interesting psychoanalytic theory; then, still in search of a beyond, of another wall to break through, he turns to dolphins, to the language of dolphins, to flows that are even stranger and more deterritorialised. But where does the dolphin flux end, if not with the basic research projects of the American army, which brings us back to preparations for war and to the absorption of surplus value.[139]

There is no doubt much truth in this critique, and it would be accurate to say that Gregory Bateson was never directly a political thinker. Indeed, Peter Harries-Jones suggests that Bateson was a distinctly "post-political" theorist.[140] Certainly, the statement by Niklaus Luhmann – a later cybernetic social systems theorist – that "it had always been clear to me that a thoroughly constructed conceptual theory of society would be much more radical and much more discomforting in its effects than narrowly focused criticisms – criticisms of capitalism for instance – could ever imagine,"[141] would seem to capture something similar to Bateson's broad ecological "post-political" position too.

Fig. 4.44 William Blake, *Satan Exulting over Eve* (1795). There are few essays by Gregory Bateson which do not refer to William Blake in some way. Harries-Jones describes Bateson's entire oeuvre as a continuation of Blake's "aesthetic attack on the dualism of natural science". Most notably, perhaps, Bateson talked of an ecological aesthetics as a second vision, as a supplement and transformation of what Blake described as the single vision of modern science. Gregory Bateson's father, William Bateson, was a collector of Blake prints, and the younger Bateson grew up surrounded by Blake's work. According to his daughter Mary Catherine Bateson, in his childhood her father had lived with this original watercolour hung in the dining room (it is now in the Tate Britain), and it had a particular significance.

Of course, Bateson did work and collaborate with many radical political thinkers. At the invitation of R.D. Laing, in July 1967 Bateson participated in the founding event of the Antiuniversity of London – entitled "The Dialectics of Liberation" – which was held at the Roundhouse in Camden, along with Frankfurt School theorist Herbert Marcuse, beat poet Allen Ginsberg, postcolonial theorist CLR James, and Stokely Carmichael of the Black Panther Party.[142] The following year, Bateson organised a conference to discuss the emerging environmental crisis, called "The Effects of Conscious Purpose on Human Adaptation", at which he invited the socialist and ecological campaigner Barry Commoner to give the opening address to a select group of invited intellectuals and activists. However, at the end of this conference, Bateson insisted that the group needed to focus on "epistemological" rather than political work in confronting the environmental question. As Noel Charlton has summarised:

> Bateson had long-standing doubts about the possibility of correcting our damaging ecological behaviour from within the radically dualist understanding of the world that we have. We see mind as separate from physical body, man as separate from nature, and the self as separate from all that we relate with. He thought that any attempt to put things right from within that framework of assumptions would be useless, possibly disastrous, and he saw the way humans develop and use 'conscious purpose' as our most dangerous feature.[143]

For Bateson, our consciousness is therefore problematic in that we are not (and perhaps cannot be) conscious of our whole mind, or indeed all of our minds. However, the nature of consciousness obscures that fact by making us think that we can or do actually know it all (or at least its limits). When the loops of consciousness are amplified through technology, the effects can be highly problematic for the individual, and also for society and environment. There was for Bateson "a systematic difference between the conscious views of self and the world and the true nature of self and the world",[144] which produces "systemic distortions of view which, when implemented by modern technology, become destructive of the balances between man, human society, and the ecosystem of the planet." However, Bateson argued, in a quasi-romantic sense, that although much of mind is inaccessible to modern human consciousness, we are nonetheless able to access or glimpse the broader ecology of mind through aesthetic sensibility. He wrote:

Ecological Aesthetics

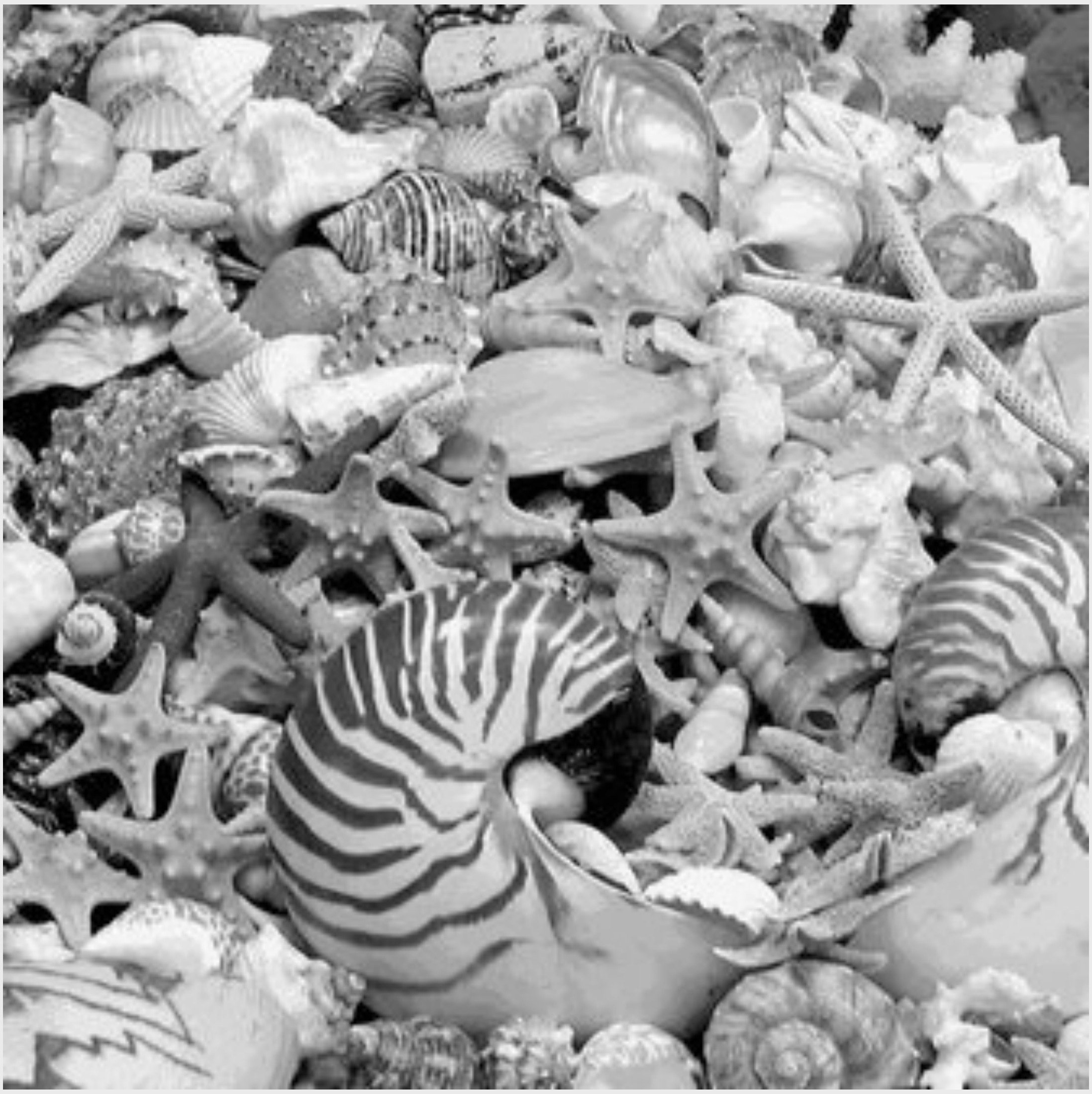


Fig. 4.45 Bateson had an intellectual exercise that he would set students, based upon a variation of the cybernetic concept of the black box (see footnote 68 in this chapter). Bateson would present the students with a crab, lobster or conch shell, and ask them to "produce arguments that which will convince me that these objects are the remains of living things." It is a fascinating challenge. He suggests that it is necessary to engage with the object aesthetically, "with *recognition* and *empathy*. By aesthetic, I mean responsiveness to *the pattern which connects*."

There is of course no simple correct answer to this challenge, but the discussion involves recognising *patterns and structures*, and speculating what *processes and relations* they might have *internalised and networked in space and in time*. Students might speculate whether it is feasible to imagine that non-living geological, technical or chemical processes are able to produce such an object, but must then end up by questioning at what level of complexity or form of processes would a geological or chemical process become "life"? In *Mind and Nature*, Bateson describes a distinctive *internal relations* approach to the challenge posed, whereby patterns of correspondence within and between shell parts are organised into a hierarchy of logical types. Bateson ultimately asks: "What pattern connects the crab to the lobster and the orchid to the primrose and all four of them to me? And me to you?"[154]

> So by ‘aesthetics’ I mean responsiveness to the pattern which connects. The pattern which connects is a meta-pattern. It is a pattern of patterns. It is that meta-pattern which defines the vast generalisation that indeed it is patterns which connect.[145]

Whilst Bateson saw himself as a scientist, his ultimate project must be understood as an attempt to transform the very basis of science (a revolutionary task which Deleuze and Guattari wanted to claim as their own), in order to introduce a second vision – an ecological aesthetics.[146] Bateson suggested that processes of empathy might be key to achieving a connection with the extended ecology of mind in which we are immersed (and which we damage by trying to stamp on our “single vision”). Over the coming chapters therefore, I will frequently return to consider Bateson’s ecological conception of mind and its legacy in relation to contemporary research in cognitive science, particularly embodied and extended mind theory. More specifically, I will suggest that a new exploration of the origins of the concept of empathy in nineteenth-century spatial aesthetics might open up some interesting ways to renew Bateson’s project.

5. Ecologies of Extended Minds

> All Bibles or sacred codes, have been the causes of the following errors: 1. That man has two real existing principles, viz: a Body and a Soul ... but the following Contraries to these are true. 1. Man has no body distinct from his soul, for that call'd Body is a portion of Soul discern'd by the five Senses, the chief inlets of Soul in this age.[1]
> [William Blake]

5.1 Dualist Legacies

Gregory Bateson introduced the problematic legacy of mind/body and mind/matter dualism, using the above quote from Blake, at the opening session of his 1968 conference on "The Effects of Conscious Purpose on Human Adaptation". Of course, Bateson had spent his whole life exploring, in different ways, the problems that emerge from the formulation of mind and matter as separate entities. As soon as that division is made – a division which can seem like common sense if we reflect (or fail to reflect) upon our experience in a particular way – then a whole series of epistemological errors will inevitably play out. For Bateson, in the western tradition this resulted in what he saw as the disastrous and near symmetrical binary of supernatural idealism and mechanical materialism:

> The two ideas are intimately related. And the relation between them is most clearly seen when we think of the mind/matter dualism as a device for removing one half of the problem for explanation from that other half which could be more easily explained. Once separated, mental phenomena could be easily ignored. This act of subtraction of course, left the half that could be explained as excessively materialistic, while the other half became totally supernatural … materialistic science has concealed this wound by generating its own set of superstitions … [primarily] the belief (not usually stated) that *quantity* (a purely material notion) *can determine pattern*.[2]

Bateson would spend much of his time trying to explain, in a variety of ways, that pattern, or quality, is a *relationship* between quantities – a *ratio* – and that this is of an entirely different, though immanent, nature. In this chapter, I will turn to consider further the trans-disciplinary intersection of ecology, and environmental systems thinking and the cognitive

sciences, as it has developed in recent theory. The kind of expanded definition of the domain of architectural knowledge, design and aesthetics that seems to be key to *seeing* the "environmental question" today requires working through this material.

5.2 Ideology - A Materialism of the Mind

In its common everyday use, to describe someone's thinking as ideological is to suggest that they cannot think independently for themselves. Nonetheless, it has frequently been observed that those who claim to be free of ideology, or in no need of it, are simply in the unconscious grip of an older ideological mindset. Ideology in this sense has a complex relationship to transparency, in that dominant ideologies often seem to disappear, as they take on the forms of 'common sense'. For many Marxist theorists, ideology is in this way a form of *false consciousness*: an imaginary, non-transparent relationship between a subject and their real conditions of existence.

When we talk about ideology in architecture, we might therefore be referring either to architectural theory in a straightforward sense or to forms of false consciousness. For the Marxist architectural historian and critic, Manfredo Tafuri, these two readings are intertwined in the very concept of "architectural ideology", which for him describes the particular role that architectural theory plays in the reproduction of capitalism.[3]

Still, it is important to note, as Terry Eagleton reminds us:

> ... this is not at all how the term 'ideology' started life. Ideology means literally the study or knowledge of ideas; and as such belongs to the great dream of the eighteenth century Enlightenment, that it might be possible to chart the human mind with the sort of delicate precision with which we can map the motions of the body.[4]

Ideology in this original sense is more like a mix of cultural theory and cognitive science, or what Eagleton describes as the possibility that the "most obscure and elusive of realities, consciousness itself, could be scientifically known", through what he suggestively describes as "a materialism of the mind."[5]

The term "ideology" was in fact first coined by the French revolutionary Destutt de Tracy from a prison cell during the Terror, as a part of what he called zoology, which for

him meant a new science of humanity. Eagleton argues – usefully reminding us that there is always an immanent politics to any definition of mind – that:

> Ideology ... belongs to modernity – to the brave new epoch of secular, scientific rationality which aims to liberate men from and women from their mystifications and irrationalisms, their false reverence for God, aristocrat and monarch, and restore to them instead their dignity as fully rational, self determined beings. It is the bourgeois revolution at the level of the mind itself; and its ambition is nothing less than to restore mind from the ground up, dissecting the ways we receive and combine our sense-data so as to intervene in this process and deflect it to desirable political ends.[6]

This materialism of mind was itself then an ideological project which aimed at rendering transparent, and therefore open to self-conscious control and improvement, the production of human consciousness. Ideology in this sense is – to paraphrase Lukacs – an *immanent critique* of the human mind *by* the mind.

Over the course of the last two centuries the concept of ideology has however shifted and expanded from this original conception. For Marx and Engels, the term is a key concept in their first major joint work, *The German Ideology,* a book which provided the basis of much of the following development of the concept. Written between April and June 1845, this text marks their decisive break with their Young Hegelian colleagues, whose work they collectively refer to in the title.

In this text, Marx and Engels argue that Young Hegelian philosophy was either still in the grip of forms of Hegelian idealism – that is to say, it describes mind and consciousness as existing outside of, or determining, the material world – or that this idealist position has been replaced, but by a *mechanical* materialism, as in the case of Feuerbach. Marx and Engels' ultimate project, of course, was to synthesise and transcend the philosophical positions of both idealism and what Marx refers to in the *Theses on Feuerbach* as "all hitherto existing materialism," through the development of a dialectical and an historical materialism – or, what I suggest, we might today further develop into a cybernetic or an ecological materialism.

In *The German Ideology*, Marx and Engels make the term ideology do a number of jobs. They are still working with the concept in its original Enlightenment sense, in that

their text contains the idea of a materialism of mind. But they are also starting to use it to describe what they see as the error of idealism: the apparent ontological and epistemological primacy given to mind over matter. They argue that, on the contrary, human consciousness is *produced* from out of our active practical and historical engagement with matter. “Consciousness is,” they argue, “from the very beginning a social product.”[7] However they also argue that this consciousness is not necessarily in any way a transparent or accurate mapping of the territory of practical material activity. Indeed, consciousness is able to obscure the very conditions of its own production: “morality, religion, metaphysics, all the rest of ideology and their corresponding forms of consciousness” are, they contend, “echoes ... phantoms formed in the human brain ... sublimates of their material life-process.”[8]

Specifically, in a typically dialectical turn, they argue that the idealism of their former colleagues is itself ideological in a second sense, since it is itself a historically specific reflection of the class conditions of eighteenth- and nineteenth-century German intellectuals. Ideology is, in this sense, as later expressed by Lukacs, a particular form of false consciousness. As Marx and Engels state in a frequently quoted passage (which I will go on to argue anticipates in all kinds of interesting ways the phenomenological cybernetics of Bateson, Francisco Varela, Evan Thompson, and others):

> ... consciousness can never be anything else than conscious existence, and the existence of men is their actual life-process. *If in all ideology men and their circumstances appear upside-down* as in a camera obscura, this phenomenon arises just as much from their historical life-process as the inversion of objects on the retina does from their physical life-process.[9]

5.3 Gregory Bateson and the Cybernetics of Mind

In many ways, when Marx and Engels state that “life is not determined by consciousness, but consciousness by life,”[10] they were still not yet being dialectical enough: they too, were constrained by the ideological imperatives of their own text. As the cybernetic biologists, Humberto Maturana and Francisco Varela, have argued in recent decades (and as discussed in Chapter Three), the very processes of life, at a cellular level, should

be described as cognitive acts, in that they are decision-based interactions between – and co-constituting – an organism and its environment. Hence it is more accurate to describe a series of feedback loops that show how life determines mind determines life, which for humans produces specific historical forms of species-mind. This kind of argument was indeed first proposed in this form by Gregory Bateson in the 1950s and 60s.

Bateson, I believe, developed something very similar to Marx and Engels' critique of the Young Hegelians. Just as Marx and Engels moved beyond both idealism and all previous materialism, Bateson too proposes a theory of mind which, in his words, is "neither supernatural nor mechanical"[11]. The key to Bateson's model is a conception of "mental process" which is based upon responses to information, which he defines as any "difference that makes a difference."[12]

For Bateson, the living world is full of minds which are all produced through material practice: they are minds that are constituted relationally, in networks, through their activity, their "actual life-process". Bateson thus sees ecosystems as ecologies of minds. He also sees organisms as ecologies of minds. Human consciousness for Bateson is extended across and within these ecologies, as an ecological condition itself, and is not in any simple way solely located in the individual brain. Bateson's ecological conception of mental processes as a series of environmentally extended minds is a properly ideological project in the original enlightenment sense: a materialism of mind.

Bateson's work anticipated by decades the recent turn in the cognitive sciences towards various conceptions of "extended mind" (albeit of course a conception that has a long philosophical history, most notably perhaps in Hegelianism). For Bateson, we are constantly participating in cognitive systems that extend throughout our environment. He states (dramatically prefiguring Lovelock's Gaia hypothesis) that:

> ... the individual mind is immanent but not only in the body. It is immanent also in the pathways and messages outside of the body; and there is a larger Mind of which the individual mind is only a subsystem. This larger Mind is comparable to God and is perhaps what some people mean by 'God', but it is still immanent in the total interconnected social system and planetary ecology.[13]

We can I believe (no doubt controversially to some) find something similar in Marx, who adopted Leibig's systems biology concept of metabolism ("stoffwechsel") throughout *Capital*, and arguably inherited from Hegel something of an extended mind, and extended organ, conception of the environment. Marx states: "plants, animals, stones, air, light, etc theoretically form a part of human consciousness ... Man lives from nature, nature is his body."[14]

Bateson's position regarding the ubiquity of mind in both natural and technical systems and ecologies varied, depending upon the argument he was making. At times he would state for example that:

> ... the elementary cybernetic system with its messages in circuit is, in fact, the simplest unit of mind; more complicated systems are perhaps more worthy to be called mental systems, but essentially this is what we are talking about.[15]

This clearly suggests that any feedback system contains mental process at some level, and he states that "the mental characteristics of a system are immanent, not in some part, but in the system as a whole."[16] Now, clearly, this depends upon what you define as a feedback loop, on the basis of internal relations. That can certainly include on occasion, for Bateson, non-living systems – and indeed he uses steam valves and thermostats as examples of basic mental systems. Yet elsewhere, when making a slightly different argument, he would also state that:

> ... there are of course many systems which have many parts, ranging from galaxies to sand dunes to toy locomotives. Far be it from me to say that all of these are minds or contain minds or engage in mental process. The toy locomotive may become a part in that mental system which includes the child that plays with it, and the galaxy may become a part of the mental system which includes the astronomer and his telescope. But the objects do not become thinking subsystems in those larger minds. The criteria are useful only in combination.[17]

It is clear from the following statement that for Bateson the issue of understanding what mind is ultimately depends upon a philosophy of internal relations:

> ... in a word, I do not believe that subatomic particles are ‘minds’ in my sense because I do believe that … the explanation of mental phenomena must always reside in the organisation and interrelation of multiple parts ... if de Chardin and Butler are right in supposing that the atomies have no internal differentiation and are still endowed with mental characteristics, then all explanation is impossible, and we, as scientists, should close shop and go fishing.[18]

Whilst Bateson was here describing an internal relations based conception of mind, he seems not to have accepted a relational-process account of matter itself (which I touched upon in Chapter Two, and will return to later in this chapter). Whilst, to be sure, a entity with no internal differentiation could have no mental properties, such an object is surely inconceivable?[19] However, Bateson does seem to shift position on the extent to which he saw all matter as actually internally differentiated and organised in a mental sense. Certainly, on other occasions he would state that mind is a property of all systemically organised matter, and he had yet to come across any other kind of matter.

Whatever the case regarding the extent to which Bateson's thinking opens out to a full-blown panpsychism or pantheism – or perhaps is just better understood as a form of hylozoism – it is clear that he saw mind as being ubiquitous in organised living systems. It is important then to note here that this does not at all mean that he regarded *mind* as *consciousness*. In fact, Bateson sees consciousness as peculiar, and in need of careful explanation. He was in a sense taking the opposite side of the Freudian position. Rather than presuming that consciousness is normal, and that the unconscious is mysterious and in need of explanation, Bateson suggests that the natural world is *full* of unconscious mental process or mind: that is what ecosystems (and indeed social ecologies) *are*. It is our consciousness that he considers to be in need of explanation, as a particular form of self-recursive and self-reflective mental activity. Indeed, in one instance Bateson described human consciousness as a recent evolutionary arrival that we should be very suspicious of! He wrote that:

> … the bits and pieces of mind which appear before consciousness invariably give a false picture of mind as a whole. The systemic character of mind is never there depicted, because the sampling is governed by purpose. We never see in

> consciousness that the mind is like an ecosystem – a self-corrective network of circuits. We only see arcs of these circuits.
>
> And the instinctive vulgarity of scientists consists precisely in mistaking these arcs for the larger truth, i.e., thinking that because what is seen by consciousness has one character, the total mind must have the same character. Freud's personified 'ego', 'id', 'super-ego' are, in fact not, truly personified at all. Each of his components is constructed in the image of only consciousness (even though the component may be unconscious) and the 'consciousness' does not resemble a total person. The isolated consciousness is necessarily depersonified. The whole iceberg does not have those characteristics which could be guessed at from looking only at what is above water. I mean: the iceberg does – mind does not. Mind is not like an iceberg.[20]

For Bateson, consciousness in the modern human psyche is actually just a small part of our total extended mind, but takes on an ideological form which obscures that fact. He stated:

> ... if consciousness has feedback upon the remainder of mind and if consciousness deals only with a skewed sample of the events of the total mind, then there must exist a systematic (i.e., non-random) difference between the conscious views of self and the world and the true nature of self and the world. Such a difference must distort the processes of adaption... It is suggested that the specific nature of this distortion is such that the cybernetic nature of self and the world tends to be imperceptible to consciousness, insofar as the contents of the 'screen' of consciousness are determined by considerations of purpose.[21]

It is worth noting here, briefly, that Bateson's use of the terms "mind" and "consciousness" is in some way the reverse of the standard use to be found in Buddhist and other mindfulness traditions of thought – and also, therefore, as we shall see, amongst some cognitive science thinkers in so far as they have been influenced by these traditions.[22]

5.4 The Nature of Mind

> It's not what is inside the head that is important, it's what the head is inside of.[23]
>
> J.J. Gibson

It has been widely observed that thinking about the nature of mind has been transformed significantly over the last decade, and certainly in the forty years since Bateson issued his monistic challenge to dualist conceptions of mind and matter. For most of the post-war period, prior to the last decade, there were three distinct disciplines which each produced quite separate forms of knowledge concerning the question of “what is mind?” Firstly, there was of course the philosophy of mind: a sub-discipline of philosophy. Then there was cognitive science, a discipline which emerged out of early cybernetics discourse but which focused in particular on Artificial Intelligence (AI) and understanding mind through the analysis of symbolic systems. Finally, there was neuroscience: the study of the biology of the physical brain. In addition to these three core disciplines, there were also psychology and psychiatry, which researched the states of mind of living humans; anthropology, which considers how mind and consciousness varies geographically and historically; and more recently evolutionary psychology, which has speculated about how human consciousness arose in prehistory. Of course, other disciplines – not least art, aesthetics and theology – would also stake claims to producing knowledge concerning the nature of mind. Increasingly, contemporary research in all of these areas has the character of hybrid assemblages of philosophy of mind, cognitive science and neuroscience, and is increasingly being categorised under the disciplinary heading of “the cognitive sciences”. Andy Clark describes the current condition well:

> ... the philosophy of cognitive science has something of the flavour of a random walk on a rubber landscape. No one knows quite where they are going, and every step anyone takes threatens to change the whole of the surrounding scenery.[24]

Before considering how the boundaries between many of these disciplines have become blurred in much recent work, it will be useful to briefly describe the distinctions and interactions between these various areas of knowledge, introduced through some of the

more relevant approaches and terms generally referred to, which have been formulated in the philosophy of mind.

We can start with the most fundamental of divisions produced by philosophers of mind: that between materialism and idealism in the most general sense alluded to above. Materialism of course holds that mind is in some way a product of matter, whereas idealism holds that matter is either an illusion, or that it is a product of mind – typically the mind of God. In these forms, both materialism and idealism are *monist* philosophies, in that they each hold that there is no fundamental ontological distinction between mind and matter (each positing one aspect as fundamental to and constitutive of the other).

There are other forms of monism. Neutral monism, for example, holds that *neither* matter nor mind are ontologically fundamental, but both are rather manifestations of another more fundamental underlying unifying substance. Both Leibniz and Spinoza can, in different ways, be described as neutral monists. It is worth noting that a significant minority of contemporary theoretical physicists have described themselves in ways that are closely related to neutral monism (often post-Bohmian thinkers, such as Roger Penrose). Dialectical monism is similar to neutral monism, again positing a deep fundamental unity of *what is*. Taoism and Buddhism have been described as dialectical monisms, and unsurprisingly, many cybernetic theorists – notably Ross Ashby, Gregory Bateson, Stafford Beer, Evan Thompson and Fransisco Varela – have found much to discuss in the practical phenomenology of mind contained in Taoist and Buddhist “mindfullness” practice.

Dualism (or more specifically, substance dualism), by contrast, holds that mind and matter are quite distinct entities. Substance dualism was most famously and influentially espoused by René Descartes in the seventeenth century and has been enormously influential in western thinking in a structural sense ever since, even whilst his particular version of it has not, as such, been seen as a credible solution.[25]

Whilst philosophical idealism remains an important intellectual tradition, it cannot be said to contribute in any straight-forward way to the contemporary theorisations of mind, which are on the whole versions of either materialism, neutral monism, or modern (often unacknowledged) dualisms.

In distinction to substance dualisms, there is another kind of dualism, property dualism, which holds that there is only one substance (typically either matter, or something more fundamental) – but that this substance intrinsically exhibits two properties, i.e. mind and materiality. Paradoxically, then, neutral monism can be seen as a form of property dualism.

Nonetheless, most contemporary philosophies of mind are a form of materialism, and fall into one of two categories: reductive physicalism and non-reductive physicalism. Reductive physicalism holds that consciousness is simply an epiphenomenon of the material processes of the brain. It holds that our experience is a by-product of unconscious biological processes, and has no causal agency in itself. This is a fairly widespread position in the underlying ideology of contemporary scientific practice and modern culture more broadly (if less so amongst actual scientists "in conversation"), although it can bring with it obvious problems. Most notably, it can be difficult, if not impossible, to account for free will, and more importantly it tends to dismiss human experience *per se* as trivial (and paradoxically thereby in practice tends towards re-inscribing a new dualism). When articulated in the language of emergence, reductive physicalism asserts that consciousness emerges *weakly* from matter: it is a purely bottom-up emergence, an incidental surface decoration.

Non-reductive physicalism, by distinction, holds that whilst the interactions of matter might produce mind, they do so in a non-reductive way – that is to say, organised matter can have properties that are not simply an aggregate of its components, and are not predictable from the unorganised parts. There are at least three stands of non-reductive physicalism. Firstly, there is strong emergence: consciousness can be *strongly emergent* and exhibit *top-down causation*. Ideas, to put it simply, are not just an epiphenomenon of interacting particles, but themselves have "autonomous" causal power (and so free will and such like is saved!).[26]

In general, the cybernetics research into mind mentioned in the previous chapter can be most easily understood as a form of non-reductive physicalism, whether we consider mind as immanent in the neural net models of Warren McCullough at one scale, or in the distributed biological, social and communication network ecologies of Bateson at a larger scale.

There are also some new forms of dualism which emerge from non-reductive physicalism. David Chalmers seems to hold that consciousness is a distinct substance, which emerges nonetheless from matter. There are still other modern dualist positions which argue that the only forms of physicalism that make sense are panpsychic.[27] Sheldrake's cosmology, for example, would fit both of these categories.

The various philosophical models of matter and mind relations briefly outlined above have of course been paralleled in many considerations of mind and body relations. Indeed, even whilst a broadly physicialist philosophy of mind has been fairly mainstream in most western thinking, and certainly in scientific thinking, for most of the twentieth century, the echoes of a mind/matter dualism has remained inscribed in dominant conceptions of a mind-in-brain/body dualism, and even a mind-in-brain-and-body/ environment dualism, which seems to be proving much harder to dislodge. Nonetheless, the dominance of the brain as the sole locus of mind or consciousness is now being fundamentally revised in contemporary neuroscience. "The mind is embodied, not embrained,"[28] Antonio Damascio reminds us, and in Chapter Seven I will review in some detail what is now known about how the *space* of the body and its environment is mapped cognitively in the brain (and how this spatial mapping is a fundamental process in the construction of the "illusion" of self.) In many ways, much of the philosophy of mind outlined above is a distinctly Anglo-American analytic philosophical discourse. Yet, as we shall see, there have been important process-based and phenomenological traditions of embodied mind thinking in twentieth-century continental philosophy which do not always align in any simple way with the more analytical approaches set out above. Notable here would be the phenomenological thinking of Martin Heidegger and Maurice Merleau-Ponty, both of whom provided approaches that were incorporated into the cybernetic bio-phenomenology of Maturana, Varela and Thompson.

Just as there has been a broad shift towards and beyond embodied and non-reductive physicalist accounts of mind in neurobiology, there have been similar shifts in the AI cognitive sciences. Here, there has also been distinctive new knowledge generated from research into artificial intelligence and robotics which reinforces the discoveries of neurobiology in fascinating ways. One of the most interesting approaches to have emerged – especially for architectural theory in this era of new claims for "intelligent",

“interactive”, “augmented” and “responsive” environments – is the *extended mind* approach. In what follows I will argue for a more dialectical formulation of the material to embrace the extended mind proposition, in a way that is ultimately related to Bateson’s broader ecological aesthetics. As such, I will turn now to discuss these embodied and extended mind approaches themselves.

5.5 Embodied Mind

> “The senses become *theoreticians* in their immediate *practice*”[29]
> [Karl Marx]

In 1991, Francisco Varela, Evan Thompson and Eleanor Rosch published *The Embodied Mind: Cognitive Science and Human Experience* as a new synthesis of phenomenology, cognitive science and biology, an approach which has since come to be known as neurophenomenology. This was an extension of the work that Varela had produced in the previous decade with Humberto Maturana: a biological form of second-order cybernetics, known as the Santiago School of Cognition. This work arguably did more to revolutionise contemporary thinking about mind than any other work in recent decades. Writing in 2005, Thompson gives an overview of this position:

> The development of cognitive science over the past two decades or so has seen a movement from the classical, cognitivist view that an inner mind represents an outer world using symbols in a computational language of thought, to the view that mental processes are embodied in the sensorimotor activity of the organism and embedded in the environment. This viewpoint has come to be known as enactive or embodied cognitive science. Enactive cognitive science ... involves the following three theses:
>
> 1. Embodiment. The mind is not located in the head, but is embodied in the whole organism embedded in its environment.
> 2. Emergence. Embodied cognition is constituted by emergent and self-organized processes that span and interconnect the brain, the body, and the environment.
> 3. Self–Other Co-Determination. In social creatures, embodied cognition emerges from the dynamic co-determination of self and other.[30]

In their book on *The Embodied Mind*, Varela, Thompson and Rosch made a series of radical moves, perhaps the most challenging and illuminating of which was their profoundly trans-disciplinary engagement with Buddhist philosophy. They note that the concept of a non-unified or de-centred cognitive subject, as it was increasingly uncovered in cybernetics and cognitive science (in for example Bateson's research), had long been theorised as egolessness or selflessness in the Buddhist tradition.[31] Presenting the book as amongst other things a dialogue between western cognitive science and Buddhist meditative psychology, given the shared discovery of a non-unified self, they argue that the Buddhist tradition is not as external to western thought as might be imagined, given that:

> ... our western histories of philosophy, which ignore Indian thought, are artificial, since India and Greece share with us an Indo-European linguistic heritage as well as many cultural and philosophical pre-occupations.[32]

They go on to suggest that the rediscovery of Asian philosophy in the west (in particular the Buddhist doctrines of non-dualism) could parallel the importance of the rediscovery of Greek philosophy in the Italian Renaissance.

The second important philosophical engagement to be found in Varela, Thompson and Rosch's book is their engagement with the European phenomenological tradition. In particular, they develop Maurice Merleau-Ponty's double conception of embodiment, in which bodies exist for us as both "outer" physical structures and "inner" lived, experiential structures: embodiment thus has a double sense in that "it encompasses both the body as a lived, experiential structure, and the body as the context or milieu of cognitive mechanisms."[33] This double condition was referred to as the "entre-deux" in Merleau-Ponty.

Varela, Thompson and Rosch rehearse the two main tendencies that have characterised cognitive science: cognitivism and emergence. Both of these can be traced in their modern form to the Macy Conference period and the "uniquely and remarkably successful interdisciplinary effort"[34] of post-war cybernetics. However, out of the various interrelated conceptions of mind that emerged in this period, they suggest – in an

important lesson for interdisciplinary work more broadly – that because of the need to define cognitive science as a mature discipline, primarily in order to gain funding:

> ... one of the many original, tentative ideas was now promoted to a full-blown hypothesis, with a strong desire to set its boundaries apart from its broader, exploratory and interdisciplinary roots, where the social and biological sciences figured pre-eminently with all their multifarious complexity.[35]

They suggest that the cognitive science that resulted was (and large parts still are) dominated by an overly cognitivist approach, which, based upon the metaphor of the brain as a computer, sees cognition as computation,[36] in the sense of the manipulation of representational symbols. As they write, this is:

> ... the assumption – prevalent throughout cognitive science – that cognition consists of a representation of a world that is independent of our perceptual and cognitive capacities by a cognitive system that exists independent of the world.[37]

They note that this approach *has* produced many insights, and also revolutionised our thinking about the self and mind. They include amongst these innovations "the multilevel conception of scientific explanation," which (paradoxically) they argue was important for theorising emergence, and even more importantly, the fact that cognitivism demolished behaviourism and its legacies in experimental and theoretical psychology, which had been dominant since the 1920s.[38] Most importantly, no doubt, all models of cognitivism also challenge the conceptions of the self to be found in "folk psychology", and indeed western philosophical traditions of the cogito, in that:

> ... cognitivism postulates mental (not just physical and biological) mechanisms and processes that are not accessible to ... self-consciousness ... one cannot discern in conscious awareness or self-conscious introspection any of the cognitive structures and processes that are postulated to account for cognitive behaviour.[39]

Whilst "folk psychology" models of self presume that consciousness and cognition are essentially the same thing, "cognitivism runs directly counter to this conviction: in determining the domain of cognition, it explicitly cuts across the conscious/unconscious

distinction."[40] In fact, for cognitivism, it is not just that cognition spans consciousness and unconsciousness, but rather that consciousness is not necessary for cognition at all. Drawing upon the work of Ray Jackendoff,[41] Varela, Thompson and Rosch conclude that cognitivism only results in a new mind-mind dualism (computational mind/ phenomenological mind) which brings with it all kinds of problems regarding intentionality and representation, which must somehow straddle both of these domains. However, Jackendoff ends up arguing that consciousness is a projection of "intermediate level representations" in a computational processes, a position that, like other cognitivist positions, ultimately ends up implying that consciousness is an unnecessary epiphenomenon.

Finding this formulation and conclusion to be implausible and problematic in all kinds of ways, Varela, Thompson and Rosch observe that "alternatives to the dominant approach of symbol manipulation … were already proposed and widely discussed during the early, formative years of cybernetics."[42] Whilst these other approaches – all based upon *emergence* in different forms – broadly fell out of favour in mainstream cognitive science for several decades, they started to reappear again from the late-1970s, not least as all kinds of self-organising material systems were discovered in physics, chemistry and biology, and non-linear and recursive mathematics, in relation to chaos and complexity theory (as briefly reviewed in Chapter Two). Notably, of course, Gregory Bateson published his collection of essays *Steps to an Ecology of Mind* in 1972, which (full of emergence thinking), and as he frequently observed retrospectively, was fortuitously published just as the tide had started to turn against hard-core computationalism (indeed his book itself became an important factor in that shift). By the time of the publication of *The Embodied Mind* in the early-1990s, the still marginal but resurgent interest in self-organising systems in cognitive science was primarily known as connectionism.

Connectionism is a form of emergence thinking which suggests that there are systems made up of simple components that give rise to emergent global states and behaviours, and which correspond to or represent properties in the world, or which correspond to specific cognitive capacities – i.e. problem-solving solutions in the world. Connectionist models are primarily based upon neural network theories, as primarily developed by McCullough and Pitts in the Macy Conference period.[43] Other important

emergence based models of cognition would include the cellular automata research of Stephen Wolfram.[44]

Connectionism could broadly be considered as a shift towards taking the found observable structure of the brain as an organisational model, whereas, by contradistinction, cognitivist models had taken early computers as a model for the brain. Because connectionist models are also closer in their organisation to the kinds of structures found in real-world biological systems more broadly, they also proved capable of revolutionising approaches to robotics and AI. Typically, connectionist models are more robust than symbolic processing models, in which the loss of parts of symbols, or the rules for manipulating them, can result in the total breakdown of computation. In emergence models, global properties are widely dispersed and networked, and are therefore much more resilient to local disruption.

More importantly, connectionist models are capable of organising themselves in such a way as to perform symbolic computational behaviour. Some connectionists therefore argue that emergence-based models are more fundamental, and that cognitivst and connectionist approaches can act as "complimentary bottom-up and top-down approaches",[45] or else can just be seen as operating at different levels or defining different domains of cognition.[46] Indeed, Varela, Thompson and Rosch *do* argue that:

> ... the most interesting relation between subsymbolic emergence and symbolic computation is one of *inclusion*, in which we see symbols as a higher-level description of properties that are ultimately embedded in an underlying distributed system.[47]

To recap, whilst Varela, Thompson and Rosch mount a sustained critique of cognitivism and all representational models of mind, they nonetheless note that at certain levels of operation, and in certain kinds of practices and experiences, human cognition certainly does work with symbolic logic and representation. Their critique of cognitivism and representation proceeds along two lines: firstly, a critique of symbol-processing as a way of working with representations, and secondly, a critique of the representational approach to cognition more generally. Asking the question, "how it is that the phenomena and behaviour that we take to be the self might arise, in the absence of an actual self?",

they outline a new “enactive” approach based upon “a view of cognition as embodied action”[48] – an approach that incorporates levels of symbolic computation within emergent self-organisation, but which goes beyond both.

The aim of Varela, Thompson and Rosch was ultimately to outline an approach to cognition that could bridge experience and science, arguing that a cognitive science that could not account for experience, in terms that were common to both, was seriously flawed. Hence our experience could only be accounted for, by including a “cybernetic” reflection upon the experience of “accounting for experience” itself, too.[49] There is, they contend, a necessary circularity to any account of mind, which mirrors the basic circularity that they open the book with: i.e. the “entre-deux” of Merleu-Ponty, in that “we are in a world that seems to be there before reflection begins, but that world is not separate from us.”[50]

Importantly, they also argued that the methods of examining experience in Buddhist mindfullness meditation practice and philosophy have a rigour that can bridge scientific knowledge and experiential knowledge, and thereby bridge the western post-war cognitive sciences and the philosophy of European phenomenology. Specifically, they write that

> ... the Buddhist doctrines of no-self and non-dualism that grew out of this method have a significant contribution to make in a dialogue with cognitive science.[51]

Hence, they stress in particular the Buddhist theories of “no-self” in relation to the fragmentation or de-centring of self in western theories of cognitivism and connectionism, and non-dualism in relation to cognition as enaction. Of course, in a very straightforward sense, too, Buddhist mindfullness practice shares something with second-order cybernetics, in that it places the observer in circuit: i.e. the observer watches the observer observe.

As a consequence, they propose an interaction between phenomenology, meditation and cognitive science that is:

> ... a change in the nature of reflection from an abstract, disembodied activity to an embodied (mindful), open-ended reflection. By embodied, we mean reflection in

> which body and mind have been brought together ... reflection is not just on experience, but is a form of experience itself.[52]

This approach is in their view a radical departure in redefining the question of the relation between self and mind:

> Descartes's conclusion that he was a thinking thing was the product of his question, and that question was the product of specific practices – those of a disembodied, unmindful reflection ... And even though it has recently become quite fashionable to criticise or 'deconstruct' this standpoint of the *cogito*, philosophers still do not depart from the basic *practice* responsible for it.[53]

Like the theories of Bateson, these more radical implications as produced by Varela, Thompson and Rosch's position have yet to be fully worked through.[54] However, their initial synthesis of cognitivism and connectivism (which they themselves then immediately move beyond), clearly anticipated a new generation of theorists such as Andy Clark, as when they presciently noted that:

> ... a fruitful link between a less orthodox cognitivism and the emergence view, where symbolic regularities emerge from parallel distributed processes, is a concrete possibility, especially in AI with its predominantly engineering, pragmatic orientation. This complimentary endeavour will undoubtedly produce visible results and might well become the dominant trend for many years to come in cognitive science.[55]

5.6 Theories of Extended Mind

"Extended Mind" is a broad term which has been used to describe a range of very different though related ideas. What unites all users of the term is some kind of grounding in *systems* thinking, arguing that mind is a *process* – not a thing or a substance – and that it is not simply located in the physical brain in the head. In extended mind thinking, it is broadly proposed that the environment plays an active role in cognition.

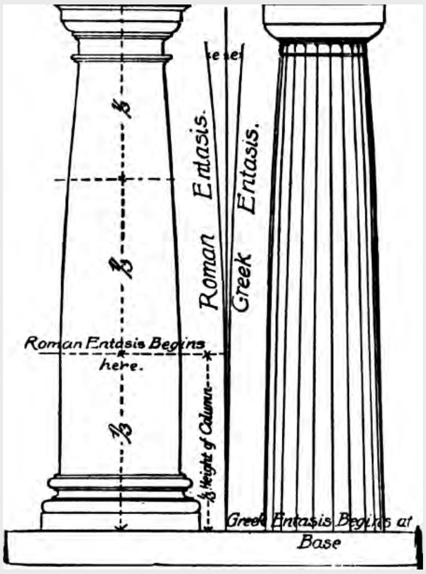
There are three independently developed uses of the term "extended mind" that have emerged in the last decade. All of these conceptions of extended mind thinking

Rupert Sheldrake's Extended Mind

Rupert Sheldrake's particular form of extended mind thinking is reflected in his controversial account of vision. Sheldrake discusses the long history of both "intromission" and "extramission" theories of vision, and concludes by proposing a model of vision based upon a two way process:

Our minds connect us to the world around us, just as they seem to do. This connection, through our sense organs, links us directly to what we perceive. What you see is an image in your mind. But it is not inside your brain. Your brain is within the confines of your cranium. Your mind is extended in space, and stretches out into the world around you. It reaches out to touch what you see. If you look at a mountain ten miles away, your mind is stretching out ten miles.[116]

He states that "through our attention, we create fields of perception that stretch out around us, connecting us to what we are looking at. Through these fields, observer and observed are interconnected." Whilst I find Sheldrake's thesis implausible in the terms that he defines it, I find the idea to be fascinating, as it captures and combines both the sense of empathy and extended mind. Sheldrake rightly challenges the representational schools of cognition, and quotes a series of thinkers whose work is based upon embodied cognition, cybernetics and ecology (Alva Noë, J.J. Gibson, Francisco Varela) and in fact builds up all of the components of an active ecological or systems account of perception. However, he then mistakes the information flow, the component that is provided by practical action – or if you like, the labour component of vision – and imagines it to be an independent and really existing mental field. Sheldrake states that "the basic idea that I am proposing is so simple that it is hard to grasp. The image of this book is just where it seems to be, in front of your eyes, not behind your eyes. It is not inside your brain. Your mind is projecting it outward to where it seems to be." In this, he is, in a sense, absolutely correct. However, what he is missing is a theory of space and time that combines practice and representation, and this missing theory has been replaced by a conception of a real field. There is, I would suggest, a real field into which we are extended, but it is not a new *morphic* field, but rather requires a process-based account of *space-time*.



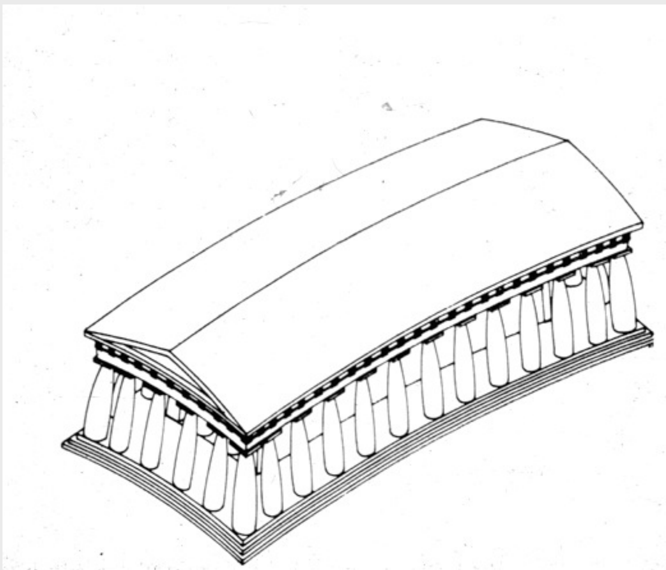


Figure 5.1-5.2 The Classical architectural device of entasis in a curious way illustrates Sheldrake's extramission model of vision, and indeed embodied vision more generally. It is not uncommon to come across accounts of entasis which describe the geometric mastery that is involved in calculating carefully distorting columns and plinths in order to account for the distortions of vision. However, it must surely be the case that, in the initial instance at least, this was not a matter of calculation, but was rather a case of generations of Greek builders carefully considering what they were seeing, and making adjustments accordingly: "up a bit.. across a bit, etc " They were in effect projecting the curvature of their retina onto the stone structure.

emphasise the structural co-evoloution of an organism with its environment, describing a fundamentally cybernetic and ecological conception of being in the world. Their core argument is that human consciousness cannot in any simple way be reduced and localised to the physical brain, but rather requires an understanding of the whole organism as embedded in ecologies of material and immaterial communication. Bateson has referred to this as “ecologies of mind”: i.e. the ways in which information, or relational networks of organised matter and energy, circulate within and between organisms and their environments. These ecologies are co-evolutionary in the sense of being historical and environmental, temporal and spatial.

The first published and most widely known account of “Extended Mind” is that of Andy Clark and David Chalmers, published in a paper of that name in 1998.[56] Robert K Logan has also been using the term since more or less the same period, although initially quite independently of Clark/Chalmers.[57] However, in recent publications Logan and Clark have begun to refer to the others work. Rupert Sheldrake has also been using the term, although not in publication until 2003.[58] Although Logan’s conception is not quite the same as Clark and Chalmers, it is in the same kind of territory, but focusing in particular on media ecologies and language. Sheldrake’s work is based within a very different panpsychic and vitalist tradition. Whilst I won’t focus on Sheldrake’s interpretation here, it is worth noting that he draws upon many of the same references from systems theory and recent cognitive research. However, Sheldrake performs what we might call an ontological reading of emergence and systems theory – arguing that organic phenomena (which include for him socio-cultural phenomena) exist within, and bring into existence, new “morphic fields.” If nothing else his account can be credited with making very visible – by by trying to imagine and resolve as real physical fields – some of the difficult theoretical problems concerning systems, emergence, causation and logic, which are often obscured in other, especially non-dialectical, accounts. For this reason, I will touch upon some of Sheldrake’s ideas at several points.

Instead however, I will primarily focus on the Clark and Chalmers thesis, in particular as it has been developed by Clark. This thesis asserts that both immaterial social environments – such as language – and material, social and natural environments, play real *active* roles in our processes of cognition. This thinking represents an important

new stage in the ongoing shift in what we think of as the nature and boundaries of self and body, and of subjectivity more broadly. It also challenges how we conceive of ourselves in relation (and as relations) to our spatial environment. As Clark has observed:

> ... it matters that we recognise the very large extent to which individual human thought and reason are not activities that occur solely in the brain or even solely within the organismic skin-bag. This matters because it drives home the degree to which environmental engineering is also self-engineering. In building our physical and social worlds, we build (or rather, we massively reconfigure) our minds, and our capacities of thought and reason.[59]

Before considering the Clark and Chalmers account in more detail, it is worth noting that there are other accounts of cognition which, whilst not using the phrase "extended mind" as such, are nonetheless dealing with similar or associated ideas.[60] In particular, throughout modernity there have consistently been varieties of extended and external mind propositions, in strong and weak forms, that have emerged from artistic practice and aesthetic theory. Of particular interest here is the concept of "empathy" that emerged in nineteenth-century aesthetics, and the closely related concept of "space" as it developed in architectural thinking, and I will dedicate Chapter Seven to exploring these concepts. Arguably, the concepts of empathy and space contain important aspects of extended mind thinking – in fact David Kirsch's analysis of the way that humans need to configure objects and ideas in space was key to the development of the Clark and Chalmers thesis, as we shall see below.

More recently, extended mind or externalist thinking has resurfaced in artistic discourse. Often it seems that this has come from artists who have particularly engaged with new digital technology, and have confronted the questions of representation that have emerged in AI, from an artistic perspective. The cybernetic artist and theorist, Roy Ascott, has frequently flirted with externalist models of cognition (often merging them with media-based extensions).[61] Ascott's former student, the artist and writer Robert Pepperell, in an interesting reading of Nicolas Bourriaud's *Relational Aesthetics*,[62] also argues that aesthetic experience cannot be understood without recourse to extended models of cognition. Pepperell writes that:

Riccardo Manzotti: A Process Oriented Externalist Solution to the Hard Problem

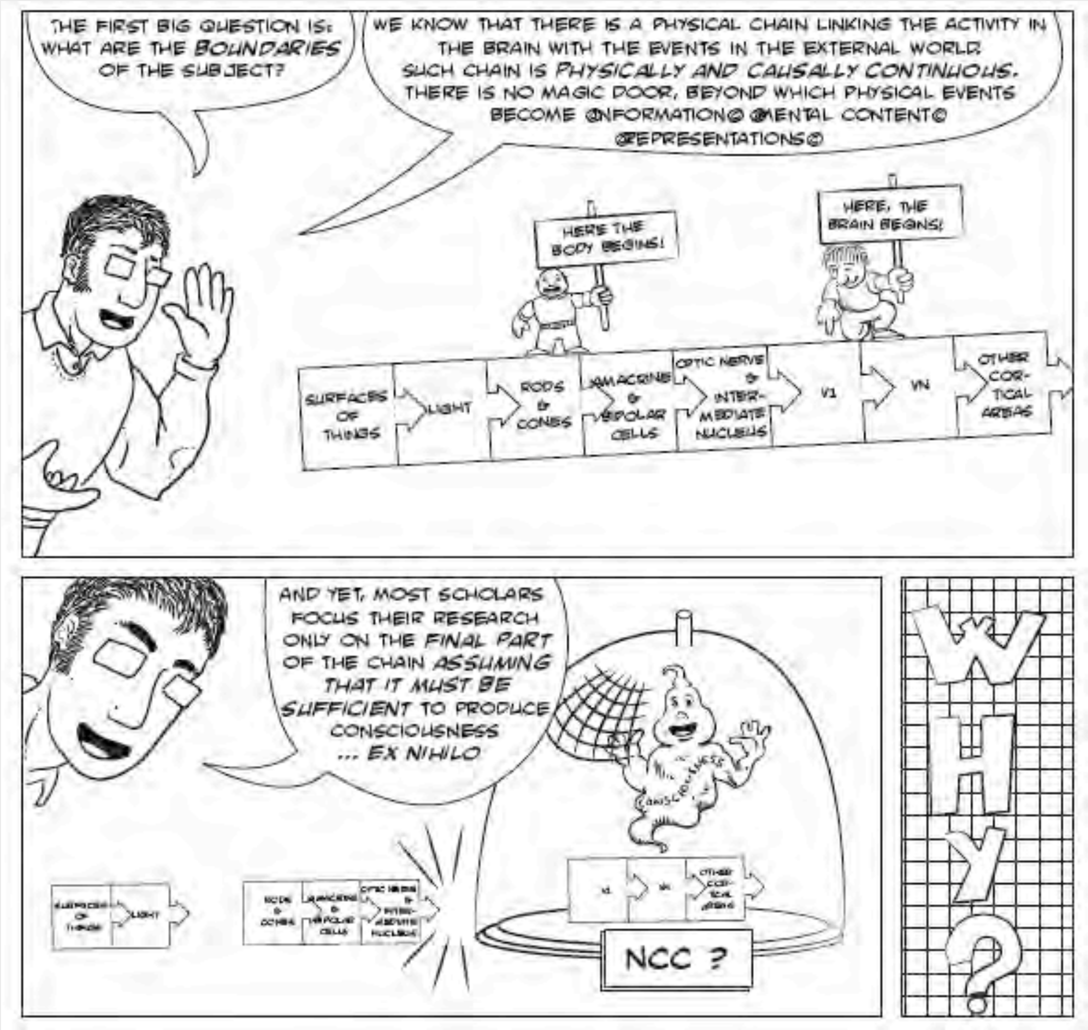


Figure 5.3 An excerpt from Riccardo Manzotti, *A Process Oriented Externalist Solution to the Hard Problem* in *The Reasoner*, Issue 2, 2008, pp.13-20. Manzotti is a professor of robotics, but his research increasingly focuses around questions based in process-based and relational based accounts of externalism.

> ... artists and art theorists have understood aesthetic activity as a distributed phenomenon, extending beyond any individual person or mind ... Extensionism stresses the extended dimensions of objects and events rather than the distinctions between them. When this approach is applied to the analysis of art it reveals the widely distributed nature of artworks and the mental qualities they convey. This is correlated with a view of the mind that extends far beyond the head.[63]

Many of these accounts of an extensionist aesthetics have developed in opposition to the recent development of neuroaesthetics, which regrettably seeks to reduce aesthetic experience solely to neural correlates within the brain.[64] They are, moreover typically dependent upon radical process-based approaches to reality in general (hence discussions often feature references to Whitehead, for example). As we shall see, this is a stronger claim about the nature of mind and reality than that which is made by Clark and Chalmers, but one that is possibly more logically consistent. I am particularly interested in considering the role that spatial environments play in extending our minds beyond the confines of our physical brains. It is clear from the discussion of Kirsch's work below, that extended mind thinking has something useful contribute to understanding how architectural and urban environments work. In the next chapter I draw together different strands of contemporary cognitive science research on the body in space, relating to both extensionist and neuroaesthetic approaches. In turning to consider empathy and space in Chapter Seven, I show how existing ideas in architecture, media theory and aesthetics might resonate with some of the extensionist approaches set out in this chapter. Throughout these accounts I will consistently restate why these questions concerning self, consciousness, ecology and aesthetics are inseparable: because in my view there is a political ecology of mind.

5.7 The Extended Mind theory of Clark and Chalmers

The Clark and Chalmers paper opens with the question: "where does the mind stop and the rest of the world begin?"[65] The term "extended mind" describes for Clark and Chalmers an "active externalism", or "the active role of the environment in driving

cognitive processes."[66] This kind of question was of course explicitly raised by Gregory Bateson, who Clark describes as one of his "large subterranean influences."[67] This question is not simply reducible to a consideration of prosthesis and tool use as extensions of the human, although Clark does indeed consider this material: he for instance, rehearses Bateson's own question regarding the status of the cane that a blind person senses with, using this as a seminal example of a general embodied tool condition.

However, whilst Clark does constantly incorporate a very wide of embodied and embedded cognitive science research into and around his thesis, the main specific thrust of the extended mind argument (as opposed to general embodiment and enaction) is that we can more rigorously demonstrate the reality of proper human cognition operating outside of what he calls our "skinbag". A central component of Clark's argument in this regard is his "parity principle". This states that if there is any process that happens in the eternal world which would be described as cognitive if it happened in the head, then it should be described as cognitive too. Clark and Chalmers state that:

> ... the human organism is linked with an external entity in a two-way interaction, creating a coupled system that can be seen as a cognitive system in its own right. All the components in the system play an active causal role, and they jointly govern behaviour in the same sort of way that cognition usually does. If we remove the external component the system's behavioural competence will drop, just as it would if we removed part of its brain. Our thesis is that this sort of coupled process counts equally well as a cognitive process, whether or not it is wholly in the head.[68]

They note that these cognitive processes are not necessarily conscious activities. Indeed, they state that "it seems far from plausible that consciousness extends outside the head in these cases" – a qualification that not all theorists would accept as meaningful. Clark and Chalmers suggest that the main challenges to their theory comes from a potential weakness in their conception of "coupling" – in that "the trouble with coupled systems is that they are too easily de-coupled," or at least it might seem to be so, especially when the tools for coupling involve apparently simple memory aids such as a *filofax* (one of the examples used in the original paper), or an *iphone* (a more recent example). They do, however, answer the question of whether potentially temporary and limited cognitive

couplings such as *filofaxes* and *iphones* might be considered as real mental components which are “core cognitive process, not an add-on extra”. What they argue is needed is just a relevant level of “reliability” in such devices, plus they note that “occasional de-coupling” can occur anyway in the biological brain through “episodes of sleep, intoxication, and emotion. If the relevant capacities are generally there when they are required, this is coupling enough.”[69] However, the really interesting question they then pose is whether “the biological brain has in fact evolved and matured in ways which factor in the reliable presence of a manipulable external environment.”[70] The existence of a real cognitive process which demonstrably extends the other processes of mind in loops that extend beyond the brain and body is, for Clark, a likely precondition that lends support to his second major thesis – which is that the human appears to be distinct from other known living creatures in the extent of its ability to plastically reorganise itself to incorporate or participate in new cognitive opportunities that arise in its environment. Specifically, Clark concludes,that human are distinct in the *degree* to which they are able to *externalise as objects and social forms* their internal cognitive processes and concepts, which they are then able to re-engage with as external objects. Humans do this through socially organised matter, spoken and written language, and through their manipulation of produced space.

One of the first examples used to describe what that might mean is that of a Tetris computer-game player who uses a rotation function to think about the morphological affordances of different shapes in different alignments, or of a Scrabble player who reorganises their letter tiles physically on the table in front of them to find new letter-word combinations. This is given as an example of the kind of structurally epistemological relationship that is set up in cognitive processes that are initiated in the brain, but which are extended and completed in the eternal world. Clark and Chalmers argue that the Scrabble player is not simply reorganising letters as *representations* of processes that are taking place in the brain, but rather is *thinking by moving* the physical letters.

They take this example, like several of their most persuasive illustrations, from a seminal paper by David Kirsch entitled ‘The Intelligent use of Space’, in which it was argued that humans actively use spatial organisation as a part of their cognitive practice. Kirsch suggests that:

> ... in having a body, we are spatially located creatures: we must always be facing some direction, have only certain objects in view, be within reach of certain others. How we manage the space around us, then, is not an afterthought; it is an integral part of the way we think, plan and behave, a central element in the way we shape the very world that constrains and guides our behaviour.[71]

In this paper, Kirsch shows that there are three distinct kinds of cognitive spatial use:

> i: spatial arrangements that simplify choice;
>
> ii: spatial arrangements that simplify perception;
>
> iii: spatial dynamics that simplify internal computation.

Examples of these would include, at a basic level, the laying out of tools and materials for use (a lot of Kirsch's initial empirical data came from filming people engaged in everyday practices such as cooking, manufacturing, etc). In all three of his cognitive spatial categories, there were complex projections between world and brain, intention, imagination and possibility. For Kirsch:

> ... it has been repeatedly shown how human agents make use of resources in the situation to help draw conclusions and solve problems rather than use abstract, symbolic computations. People make mental tools of things in the environment.[72]

This insight is a useful one. The classical cognitive science approach was based upon the idea that the mind worked by producing an internal representation of the external environment. This is indeed largely how we seem to experience things: we see the eternal world, but we also seem to have an internal representation of that world. If we close our eyes we can still conjure up representations, and this visual model largely provided the basis for the classical cognitive conception of mind. All of our highest cognitive faculties, such as designing or planning, seem to rely upon such internal representations. Not surprisingly, early attempts at building artificial agents such as robots or computers started from this basis, and attempts were (and continue to be) made to get the robot or computer to form a rich internal representation of its environment as the basis of its understanding

of, or movement and action within, its environment. In such a schema, the mind is being conceived as wholly located in the brain, or in the robot or computer, which then instructs the body or the machine what to do.

However, it has become increasingly clear that any attempt to create sufficiently rich environmental representation in this way is highly information and memory intensive. Equally, this potential flood of incoming information to the mind or constructed machine has no necessary inherent meaning, and thus attempts to programme how robots or computers can identify important features in the environment – a process which seems simple and self-evident to us – has proved exceptionally difficult to do. Similarly, even the most basic motor actions, such as grasping or moving, are now understood to be highly complex cybernetic feedback systems, which again are very difficult to replicate in robots or computer using the top-down symbol processing based methods that internalised representational models require.

A shift hence occurred in the 1990s regarding thinking around how to make robots navigate environments – a shift which paralleled ideas emerging at the same time in the neurobiological cognitive sciences. This shift was characterised by Clark in his paper on “Embodiment and the Philosophy of Mind” as a move away from what he defines as an “isolationist” position: the notion that the mind creates an entire internal representation of the external world, which it then uses to navigate and act in the world.[73] As Clark notes, “possession of such a rich inner model effectively allows the system to ‘throw away’ the world and to focus current computational activity in the inner model alone.”[74] This model, whether used as a means of understanding the human mind, or as a means of trying to build artificial agents that could act in the world, kept running up against problems mentioned above. Increasingly, anti-isolationist positions developed, with Clark arguing that:

> ... mind itself is not, after all, a special realm populated by internal models and representations so much as an inextricable interwoven system, incorporating element of brain, body and world – a system which resists informative analysis in terms of the old notions of model, representation and computation. [75]

Top-Down Computation vs Morpho-Ecological Dynamic Passive Systems

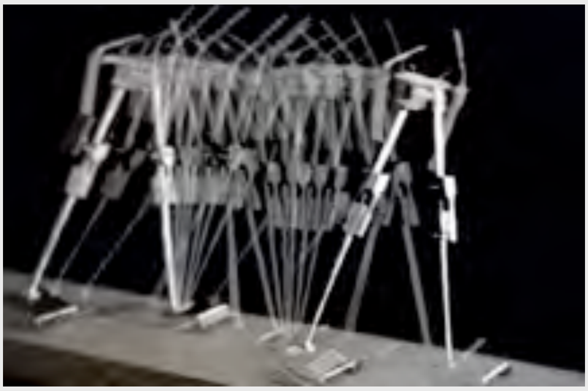


Fig. 5.4. Honda's Asimo (short for Advanced Step in Innovative Mobility). Asimo is a purely "top down" walking device, in that its movements are entirely driven by instructions to move motors, etc. It mimics the movements of a human, but uses lots of energy and computing power to do so (and is extremely expensive to make).

Fig. 5.5 The Collins Passive Dynamic Robot contains no processor or control or even motor mechanism *at all*.[117] It is rather a carefully balanced and jointed assemblage which when placed upon a slope, will walk down it, powered by nothing more than gravity. Moreover, these passive dynamic systems typically perform with what is frequently observed to be a "life-like" gait. This corresponds to studies of toddlers learning to walk.[118] Toddlers are better at walking on sloped surfaces, which suggest that we learn to walk through a form of controlled falling over. We can, I think, easily reconstruct this ourselves, by "bounding" down a staircase or slope with minimal self-control. Developments in passive dynamics show how morphology and context are able to *ecologically embody as a system* the equivalent of vast amounts of "processing". Pfeifer and Bonard have described this as "morphological computation". For Clark, these are examples of what he calls "nontrivial causal spread", which he defines as "something we might have expected to be achieved by a certain well-demarcated systems turns out to involve the exploitation of more far-flung factors and forces." There is more to make of these examples from Clark, however, as I think that they open several levels of thinking about embodiment, not all of which he considers. It is not simply the case that these are examples of devolved organisation and cognition (as Clark tends to describe it), as if there is a central control which then outsources. In fact, I would imagine that, on the whole, cognitive faculties accreted around these morphological constructions. For example, whilst an organism might make maximum use of morphological computing, it still needs some kind of control mechanism, even if for nothing else than stopping adjusting direction etc. What must happen is an ever more complex second-order layer of neuronal structures are assembled simply to manage an action. However, this is also how mind is embodied in another sense, specifically in the way that Lakoff and Johnson describe it. That is, walking, even in the morpho-ecological dynamic passive system, is a structured set of *relations* – it is in fact a *concept,* embodied (just as architecture embodies social concepts in buildings). Similarly, it is these embodied conceptual structures, and the neuronal assemblages that later mirror and fine tune them, which then provide the basis for *a conceptual structure in general*, once *abstracted* from their original embodiment (I discuss this kind of embodiment further below, in relation to Lakoff and Johnson).

Instead of the agent necessarily relying upon a rich internal representation of the world, allowing it in effect to "throw away the world", anti-isolationist positions argued that:

> ... bodily actions (such as saccadic eye motions) play vital computational roles, and that repeated agent-environment interactions obviate much of the need to create all-purpose, detailed internal world models. Instead, we visit and re-visit different aspects of the scene as and when required, allowing the world to function as 'its own best model'.[76]

As Clark emphasises, what is really important is not only the extent to which any process is representational or not, but also the degree of agent-environment coupling that the different models require. Anti-isolationist neural set-ups are based upon what Clark describes as "action-oriented" engagements with the world. They tend towards a "radical interactionism" with "dense, reciprocal causal exchanges uniting agent and environment in a complex web of mutual influence."[77] This, Clark suggests, has only been modelled in any useful way through dynamic systems theory, in particular as set out by Scott Kelso.[78]

Richer internal representations are, by contrast, more "action-neutral" by necessity, and whilst they seem to offer more flexibility of action response, they obviously require another layer of relational concepts to process the representations. In addition, the action-neutral model of the representational mind requires as noted some kind of massive data storage.

Recent work in both robotics and biology now strongly suggests that these action-neutral, representation-heavy isolationist models are rare, whether in non-human nature, and in any kind of artificially constructed robot agent. Clearly, however, humans are one strikiing example where both models co-exist. Clark suggests that for this to be the case, "the use of such representations coincides, rather exactly, with the possession of a rich public language."[79]

These kinds of shifts in conceptions of mind that have been unfolding in the cognitive sciences for more than a decade, are, as Clark acknowledges, a return to many of the insights of first-generation and second-generation cybernetics – and more broadly to the ecological psychology of J.J. Gibson, as well as much modern continental phenomenology.[80]

Fig. 5.6. Leon Battista Alberti (1404-72), Basilica Sant'Andrea, Mantua, Lombardy, Italy (built from 1462 to 1494 - latter additions until 1742).

Victoria Watson has suggested that a conceived split between mind and matter “haunts architecture’s understanding of the relationship between ideas and things.”[119]

Watson argues that in this basilica by Alberti it is possible to experience through the “quality of the spatial relationships” an idea embodied in the building, which is self-reflexively about building, and about the relation between matter and mind. She suggests that “it is as if Alberti... [was] drawing forth ideas to test the proposition that there might be a harmonious link between imaginary projection and sensual experience... to discover direct connections between imaginary forms arising in the mind and the embodied sensual experience of measured spatial relationships.”[120] Watson reminds us that the emergence of architecture as a discipline and profession – often located at the event of Alberti’s publication of *On the Art of Building* – was grounded in a valorised division between mental and physical labour, between producing ideas about buildings, and producing the matter of buildings. For Watson, Alberti’s work, and working practice (and indeed that of the emerging architectural profession) were in complex ways aware of, and indeed about, the recursive dualism of mind/matter, idea/thing, thinking/making and architect/builder.

In this sense, Clark and Chalmers want to argue that:

> ... evolution has favoured on-board capacities which are especially geared to parasitising the local environment so as to reduce memory load, and even to transform the nature of the computational problems themselves ... evolution has found it advantageous to exploit the possibility of the environment being in the cognitive loop.[81]

Clark frequently cites, in this regard, research by Ullman and Richards, or by Blake and Yuille,[82] which shows how our visual systems have developed a series of mechanisms that take advantage of the typical spatial structures found in the external world, and also take advantage of our relative motility as a species. Humans do not simply see what is in front of us, but rather we visually couple ourselves kinaesthetically with a particular kind of spatial environment. For example, it seems when presented with exercises that involve transferring information about one set of objects to another, in the way that the eye saccades across a scene, what is happening is that the eye-brain is using the world as a database.[83] Rather than immediately placing into memory everything that is being seen, the eye constantly returns to collect data as required.

The kinds of environments that extend cognition are not however exclusively physical. Language is for Clark and Chalmers a fundamental and social medium by which cognitive processes are extended into the world.[84] Interestingly, they use the fish-in-water analogy to describe the role than language plays as an extended cognitive medium within which we are embedded and immersed, through a “sea of words” and a “linguistic surround [that] envelopes us from birth.”[85]

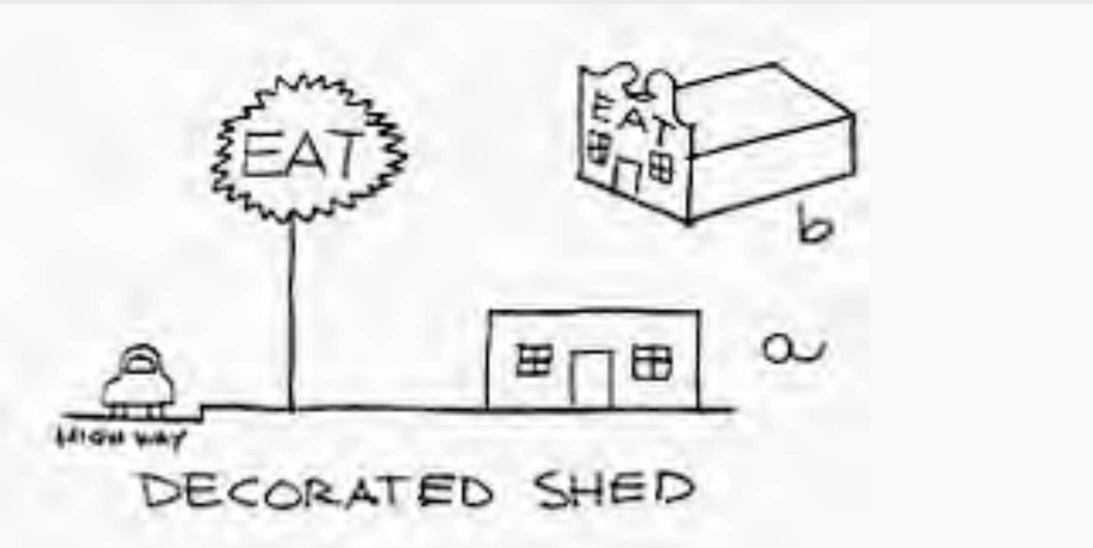
5.8 The Embodiment of Concepts

An important variation of post-Santiago School conceptions of mind embodiment was developed by George Lakoff and Mark Johnson, out of, and as a critique of, Anglo-American philosophical cognitivist discourse. Lakoff and Johnson are situated within the Cognitive Linguistic[86] philosophical tradition, but, in their 1999, work *Philosophy in the Flesh*, they effectively positioned themselves in relation to Varela, Thompson and Rosch’s

Fig. 5.7 H_2O pavilion by NOX, and Fig. 5.8-9 Robert Venturi, Denise Scott-Brown and Steven Izenour, Decorated Shed concept, from *Learning from Las Vegas* (1972).

The relationship between ideas and things is not, however, the only haunting of dualistic conceptions of mind and matter in architecture. Fransisco Varela has shown that ultimately what unites all cognitive organisms – from cells upwards – is the act of *sense making,* or the construction of meaning, in and as their environment. A simple reflection upon one's own experience of architectural environments suggests that there are two distinct categories of spatial media experience: physical and symbolic, or kinaesthetic and iconographic. In the first case, there is meaning that is generated through the direct experience of the body in material physical space. In recent architectural theory – in for example the writing of Juhani Pallasmaa – this is often what is meant by "phenomenology" in fact. In the second case, there is symbolic meaning, carried by or as the built structure. In most spatial environments, of course, both of these processes happen simultaneously, and the physical forms of buildings both generate kinaesthetic and organisational significance themselves, plus they simultaneously act symbolically, or as organising frames for other signifying media.

These two poles (Kinaesthetic/Iconographic) might be illustrated by the experiential landscape of the NOX H_2O Pavilion (kinaesthetic), and Robert Venturi and Denise Scott Brown's duck/decorated shed sketch (iconographic). In the H_2O Pavilion, Spuybroek was interested in the experience of space and form as a prosthetic, something directly felt, whilst in the sign research, Venturi and Scott Brown were exploring how architecture works as a symbolic language. I have written about this some years ago,[121] and at that time suggested that these two types of signification were actually processed in different parts of the brain. I suggested that kinaesthetic experience was processed in "older", pre-language regions, and iconographic in "newer", cognitive regions. That seems to me now to be slightly inaccurate, although the relation still stands. Rather, I would now suggest that we might understand the *iconographic* in relation to *cognitivist* models of representational computation, and the *kinaesthetic* in relation to *embodied cognition*!



The Embodied Mind. In a statement that characterises in general terms all of the above positions, they declared that:

> ... there is no true separation of mind and body. These are not two entities that somehow come together and couple. ... rather, mind is part of the very structure and fabric of our interactions with our world.[87]

So instead of discussing what they refer to as the “trivial” case of embodiment – by which they mean the notion that mind emerges in some way from a brain that is embedded in a body – Lakoff and Johnson argue that mind is also embodied in a more important sense, in that *all* of our conceptual structures are ultimately reducible to (or explicable as) “metaphors” based upon our bodily experience. Early in their text they use an example reminiscent of Santiago School thinking to support the contention that all categories of thought are based upon actions. They suggest that:

> ... every living being categorises. Even the amoeba categorises the things it encounters into food or non-food, what it moves towards or moves away from. The amoeba cannot choose whether to categorise; it just does. The same is true for every level of the animal world ... How animals categorise depends upon their sensing apparatus and their ability to move themselves and to manipulate objects.[88]

They contend that reason and language are thus embodied in a profound sense, in that “reason piggyback[s] on perception and motor control.”[89] We *reuse* and *adapt* the structures and categories developed for sensing, perceiving and acting, in order to be able to also develop more abstract conceptual thought:

> ... an embodied concept is a neural structure that is actually a part of, or makes use of, the sensorimotor system of our brains. Much of conceptual inference is, therefore, sensorimotor inference.[90]

As a result, Lakoff and Johnson describe two “conceptions” or “generations” of cognitive science, which roughly correspond to the two established orders of cybernetics discussed previously. Their first-generation they characterise as the “Cognitive Science of Disembodied Mind”, whilst the second-generation they call the “Cognitive Science of

Fig. 5.10 Chernikov, constructivist synthesis of kinaesthetic and iconographic. It is also interesting to note that whilst the classical theory of architecture arguably achieved a theoretical and formal synthesis of kinaesthetic and iconographic modes of architectural cognition (see Alberti above), modern architectural knowledge never did manage to formulate a unified theory and practice of spatial media – the closest to a modern synthesis would be constructivist architecture – in fact this is one way to understand modern architecture's repeatedly announced crisis.

Thinking about the extended mind and cognition in relation to architecture does not just help us to understand the role that building and living in structured environments has played in building ourselves, and our other extensions (language in general, etc). It can also help us to think about the extended mind, and the embodied cognitive practices, of the architect him/herself. The most straightforward way that mind is extended, is through tool use. For architects, the tools of the trade, which produce the mind of the architect, would include directly and traditionally, drawing tools such as pen and pencil, and more recently, various interfaces to CAD software packages. All of these tools can be shown to extend the architectural mind in historically specific, ways.[122]

Embodied Mind".[91] They describe the first-generation as a modern version of the Cartesian viewpoint that reason is transcendental. This model implicitly worked with a dualism of mind and body, in that mind was embodied in a merely 'trivial' sense, in that it needed hardware for the software to run on. However, "functionally, mind was disembodied" and "symbols characterising thought were taken as internal representations of an external reality."[92]

Second-generation cognitive models, by contrast, propose that the "software" of mind does not run upon a neutral brain-computer, but rather is built up out of "our sensorimotor experience and the neural structures that give rise to it", including "our motor schemas and our capacities for gestalt perception and image formation." Lakoff and Johnson argue that this means that our "mental structures are intrinsically meaningful by virtue of their connection to our bodies and our embodied experience." This primary level of cognition is then, they argue, mirrored and abstracted in our higher brain functions:

> ... our brains are structured so as to project activation patterns from sensorimotor areas to higher cortical areas. These constitute ... primary metaphors. Projections of this kind allow us to conceptualise abstract concepts on the basis of inferential patterns used in sensorimotor processes that are directly tied to the body.[93]

Throughout their book, Lakoff and Johnon make the case that all conceptual structures are ultimately derived from abstracted and metaphorical physical experience, and that "reason is imaginative in that bodily inference forms are mapped onto abstract modes of inference by metaphor."[94] In fact, they argue that it is precisely this metaphorical abstraction out of the body that makes the Cartesian dualistic position seem plausible in the first place.[95] Hence they suggest Descartes' particular conception of a disembodied mind arose out of the "knowing as seeing" metaphor,[96] and that, more paradoxically, "our very concept of a disembodied mind arises from embodied experiences that every one of us has throughout our life."[97] In particular they contend that our experience of our body as a bounded container leads us to project inwards this conception, once mind is experienced self-reflexively:

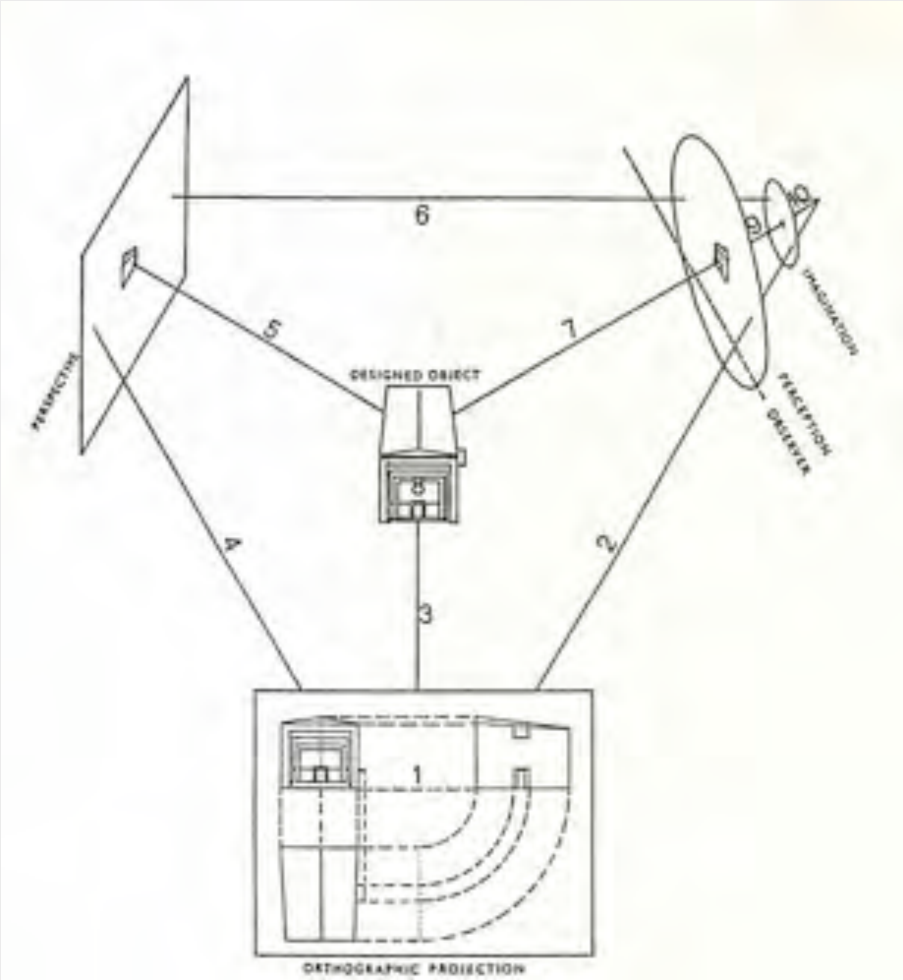


Fig. 5.11 Robin Evans, 'The Arrested Image', from *The Projective Cast - Architecture and its Three Geometries* (1995). More intriguingly, for considering the nature of the extended mind and the discussion of empathic projection in Chapter Seven, is a model of extended mind thinking that comes directly out of architectural theory. In *The Projective Cast,* Robin Evans produced a speculative expanded field of projective relations, in order to try to capture the mutual construction of drawings, designed objects, perception and imagination, which he called "The Arrested Image".

In this diagram, Evans describes "ten fields of projection" connecting five "objects", which are "almost always thought of as pictures or picture like." Evans positions the observer as a plane of intersection at one of the corners, intersecting three of the fields of projection. Behind this plane the fields of projection continue, and Evans positions the imagination here, although noting that "the status of these lines as they pass across the border into consciousness is not at all clear."

In *The Projective Cast*, Evans was concerned precisely with considering how architecture was conjured as the relations of a system whose loop ran between: imagination, projection, action, making, perception, projection and back to imagination. Whilst much of his history is concerned with excavating particular historical instances of projective relationships and their role in the production of objects and minds, it is clear in his conclusion that his ultimate object of enquiry was in fact the role that representation – and by implication architecture – plays in our imagining of our minds. Evans stated, in the kind of alchemical language that so often characterises discussion of projection, that

> ... design is action at a distance. Projection fills the gaps; but to arrange the emanations first from drawings to buildings, then from buildings to the experience of the perceiving and moving subject, in such a way as to create in these unstable voids what cannot be adequately portrayed in designs - that was where the art lay ... the boundary between world and self, the objective and subjective. There are two further targets, the perception and the imagination belonging to the observer, and two further projective spaces behind them. Imagination and visual perception are shown as pictures, because that is how they are normally described. They are not pictures, but the fact that they are thought of in that way is very significant.[123]

> ... we conceptualise the mind metaphorically in terms of a container image schema defining a space that is inside the body and separate from it. Via metaphor, the mind is given an inside and outside. Ideas and concepts are internal, existing somewhere in the inner space of our minds, while what they refer to are things in the external, physical world. This metaphor is so deeply ingrained that it is hard to think about the mind in any other way.[98]

Despite the often distinctively traditional liberal humanist character of much of their thinking, Lakoff and Johnson do nonetheless provide useful material for helping to "flesh out" Marx's suggestive comments in, for example, the *Paris Manuscripts*, in regard to the way in which "the senses become theoreticians in their immediate practice." However, it seems doubtful to me that Lakoff and Johnson's attempts to push body-based metaphor as an explanation for all human conceptual practices can be fully accepted without some amendment. Firstly, they do not really take into account the kinds of mechanisms that mirror neuron research has now revealed regarding the incorporation of external tools into the organism and its sensorimotor mappings (as will be discussed in Chapter Seven). Presumably, this must mean, that just as according to Lakoff and Johnson's the neuronal structures that arose to control our bodies then provided the basis of our more abstract thinking ("piggybacking" as real metaphors), if today we are technologically and spatially extending our "cyborg" bodies in new ways, then the new neuronal formations that are thereby plastically produced (and indeed neuronal circuits with non-neuronal elements) must create the conditions for new kids of conceptual metaphors? More broadly, the way that we re-project our abstractions back out into the world, before reincorporating them once more – which is, I argue, the basis of the kind of recursive mirroring through which our higher self-consciousness is produced – would seem to require a more reflexive and dialectical metaphor process than they describe: something in other words which can deal with embodiment in the context of a technologically extended body, and more broadly with what Marx described as "nature as man's inorganic body".

Lakoff and Johnson do however make some steps in the direction of this last point, in the ecological ethics they outline towards the end of their book. In a particularly interesting section, they argue that spiritual experience is essentially embodied, and that a new understanding of our embodiment could lead to a new kind of non-religious embodied

sense of spirituality. The general direction of this thinking has much in common with the attempt by Gregory Bateson in his final years to define a secular conception of the sacred as immanent to the organisation of matter, and in particular, living systems. Crucially, in relation to the next chapter of this thesis, Lakoff and Johnson connect their embodied ecological spirituality with processes of empathy and projection:

> ... the environment is not an ‘other’ to us. It is not a collection of things we encounter. Rather, it is part of our being. It is the locus of our existence and identity. We cannot and do not exist apart from it. It is through empathic projection that we come to know our environment, understand how we are a part of it and how it is a part of us. This is the bodily mechanism by which we can participate in nature, not just as hikers or climbers or swimmers, but as part of nature itself, part of a larger, all-encompasing whole. A mindful embodied spirituality is thus an ecological spirituality.[99]

The kind of ecological expansion of mind that Lakoff and Johnson suggest is congruent with Bateson’s conception and offers a proto-political awareness that other embodied mind theorists also tend towards. For example, Clark and Chalmers make similar claims for the basis of a new mental-ecological culture. Reviewing the impact of their extended mind thesis, they observe that:

> ... there are obvious consequences for philosophical views of the mind and for the methodology of research in cognitive science, but there will also be effects in the moral and social domains. It may be, for example, that in some cases interfering with someone's environment will have the same moral significance as interfering with their person. And if the view is taken seriously, certain forms of social activity might be re-conceived as less akin to communication and action, and as more akin to thought. In any case, once the hegemony of skin and skull is usurped, we may be able to see ourselves more truly as creatures of the world.[100]

5.9 Emergence, Process and Dialectics

I have referred to emergence repeatedly in the preceding pages. The term has become a critical, and much disputed, concept in physicalist (and post-physicalist) accounts of mind

Design Research: Emergent Form in Architecture

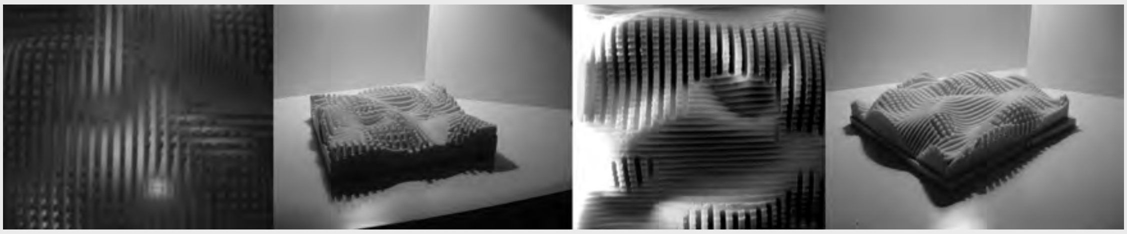


Fig 5.12 Chris Bolland (Polytechnic Studio student 2003), studies in emergent form using computer aided milling machine. Weak emergence is a common property of iterative design processes. Emergence in this architectural sense is now often associated with parametric methods, and/or the so-called “morpho-ecological”, and generally refers to emergent form: form which is not planned or designed in a conventional sense, but rather emerges as an expression of a field of forces. Typically, these forces might include projected environmental forces such as wind and sun, or socio-phenomenological forces such as view directions. Examples of this approach are well documented in for example Michael Hensel, Achim Menges and Michael Weinstock, *Emergence: Morphogenetic Design Strategies* (Wiey: Architectural Design, 2004) and Michael Hensel, Achim Menges and Michael Weinstock, *Emergent Technologies and Design* (London: Routledge, 2010).

Fig 5.13 Erich Mendelsohn, Red Flag Textile Factory, Leningrad 1926. In many ways, however, emergence has a much longer history within modern architecture, and claims for form as an expression of forces was, for example, articulated in this sense by the Expressionist and Futurists (and indeed by empathy theorists). In fact, there is an important sense that a conception of strong emergence is active in this earlier work. In, say, Erich Mendelsohn’s attempts to both respond to, and intensify, the experience of automobile flows and general metropolitan dynamics (material and immaterial) around his buildings (note the tram and telegraph poles in the street), we find both a bottom-up form of weak emergence (i.e. the analysis or intuition of existing forces) and top-down strong emergence (the recursive intensification of those forces and affects).

and organism. Given also that emergence is also a term broadly used in certain areas of architectural and urban theory, it is worth considering it further here.

As discussed in previous chapters, there is an important history of thinking about whole/part relations, which in western philosophy certainly goes as far back to Aristotle's observation that "the totality is not, as it were, a mere heap, but the whole is something besides the parts."[101] This history also includes in important ways both the traditions of organicist philosophy and even the very origins of architectural knowledge as a social conception of whole/part relations in built space.

Emergence, which was first used as a term in the 1920s by thinkers such as Samuel Alexander, C.D. Broad, C Lloyd Morgan and Henri Bergson,[102] is historically associated with a particular strand of British philosophy,[103] and lay at the core of much of the systems thinking of the twentieth century. To recap, then, emergence is generally defined as the formation of properties and qualities within a systemic whole, which arise through a process of self-organisation in the parts of the system. The difficulties of the concept concern the ontological status of the whole as a system, or how to theorise the relationship between *pattern* and *matter*.

It should be noted that emergence is often used in a somewhat lazy and un-reflective sense to describe processes which are better referred to as the *resultant* of a series of linear forces or affects. In its stricter semse, however, Mark Bedau has argued that the discussions around emergence within systems theory can be split into the two distinct forms previously noted: i.e. strong and weak emergence. Weak emergence describes the appearance of new forms, behaviours or properties which arise in a system due to the collective interaction of the parts, but where those properties might still be present in, and ultimately predicable from, the behaviour of those parts. Bedau notes that "it is the ubiquity of weak emergence in complex systems that makes weak emergence especially interesting."[104] Weak emergence is often described as being bottom-up, in that it is the parts which produce a new whole.

Strong emergence, by distinction, describes a condition in which the parts produce a whole, but the latter itself then (or better, simultaneously) exhibits a new form of downwards causation on the parts, and as such is more challenging for many thinkers.

Bedau, who is ultimately sceptical regarding the existence of strong emergence, suggests that:

> ... although strong emergence is logically possible, it is uncomfortably like magic. How does an irreducible but supervenient downward causal power arise, since by definition it cannot be due to the aggregation of the micro-level potentialities? Such causal powers would be quite unlike anything within our scientific ken. This not only indicates how they will discomfort reasonable forms of materialism. Their mysteriousness will only heighten the traditional worry that emergence entails illegitimately getting something from nothing.[105]

A classic case for strong emergence has been made by certain non-reductive physicalist strands of cognitive science. Proponents claim that that the material base of brain/body/world is material, but its activity gives rise to mind, which is immaterial. The point of claiming strong emergence is that it is not necessarily positing a dualism (i.e. that there is mind outside of matter), nor is it a reductive physicalism (i.e. arguing that there is nothing to explain). Emergence in this strong sense is specifically the claim that genuinely new properties emerge from and through organisational patterns.

David Braddon-Mitchell's scepticism is typical of challenges to the notion of emergence, suggesting that it is always disguises forms of dualistic thinking:

> ... emergentism is the intuitive idea that whatever is emergent emerges from the base ... while consciousness is genuinely novel, the ingredients are not. It emerges from a physicalistically kosher base ... a marvellous trick: nothing fundamental is nonphysical, but consciousness is genuinely novel, and nonphysical, even though it is nomologically tied to the physical base. This is the standard that I'll be holding emergentism to, and which I doubt that it can meet.[106]

David Chalmers, who believes that consciousness can only be explained on the basis of strong emergence, more or less states the obvious when noting that:

> ... strong emergence has much more radical consequences than weak emergence. If there are phenomena that are strongly emergent with respect to the domain of physics, then our conception of nature needs to be expanded to accommodate them. That is, if there are phenomena whose existence is not deducible from the

Emergence and self-organisation

Fig 5.14 Starlings flocking over Brighton Pier form dynamic wholes, which act as proto-super-organisms.

Fig. 5.15 Self-organisation and emergence have become politicised in much grassroots green left discourse, and contemporary movements such as UKuncut and Climate Camp try to use these theorised to create a political discourse that might develop its own structures, rather than using more conventional hierarchical organisational structures. Equally, ideas of emergence and self-organisation have been used on the right, by neo-liberal economists such as Hayek, and in some descriptions of the Big Society. I discuss the need for political ecology and radical cybernetic based critiques of these ideas in Chapter Eight.

> facts about the exact distribution of particles and fields throughout space and time (along with the laws of physics), then this suggests that new fundamental laws of nature are needed to explain these phenomena. [107]

Much of the conceptual difficulty that surrounds these different formulations of emergence arises from two different though connected kinds of explanation, which can be respectively described as epistemological and ontological. In this distinction, ontological strong emergence describes the production of real new properties that cannot be predicted reductively from the existing parts nor are in any simple linear way determined by them. Epistemological strong emergence, on the other hand, describes situations where, it is argued, it is not possible for us to know or model in a deterministic manner a given system, but that nonetheless the system is in principle deterministic. Epistemological emergence concerns the *method* of reductionism in our thinking about any system, rather than the *doctrine* of determinism. Although there is much dispute over the validity of real world examples, many systems which are often described as chaotic are, it is suggested, only seemingly non-linear and unpredictable from the outside, but are nonetheless deterministic systems themselves. However, practically all of these terms are disputed in various ways.[108]

A second and perhaps even more important conceptual difficulty seems to arise from a failure to define and reflect upon what exactly is meant by whole and part, or what is the conceptual form and concrete reality of the *spatial* and *temporal* inter-relation between whole and part. As Thompson suggests, the most coherent way to think about emergence is in terms of what he describes as “dynamic co-emergence”, in which it ultimately makes no sense to discuss whether the parts reductively contain micro-properties of the whole, given that “part and whole co-emerge and mutually specify each other.”[109]

Intriguingly, these critical scientific and philosophical concerning the epistemological and ontological status of self-organising systems, their knowability by other self-organising systems (in particular, their knowability both within, and as a part of our human experience), and the need to maintain a complex co-determined conception of

whole-part relations, has provided the context for a renewal of interest in the project of a "dialectics of nature", and of Friedrich Engels' prefiguring of a theory of emergence.[110] As Lucien Sève makes clear, a dynamic co-emergence approach is necessarily dialectical:

> ... in an organic totality, the whole forms its parts and is simultaneously formed by them through embryological or historical processes. Playing in this way an active role in the production of its parts, the whole also leaves an imprint on them. Hence a paradox that is inconceivable from a non-dialectical point of view: in a certain sense, the whole is present in each of its parts, which can then be said to belong to the whole in a very unusual way.[111]

For Sève the dialectical tradition provides ways to deal with the seemingly *ex nihilo* arrival of new properties and qualities in systems that many contemporary theorists of emergence struggle with:

> ... a key merit of the dialectical category of 'jump' is that it completely rejects any attempt to dismiss or trivialise the newness of the new ... the disturbing fact that [although] ... the acquisition of new properties by the new quality is necessary and therefore foreseeable from a quantitative point of view, it may none the less be qualitatively unpredictable.[112]

Ultimately, a dialectical systems concept of materialism suggests that the contradictions found in theses of strong emergence are based in a particle-based metaphysics. Although it is beyond the scope of this thesis to explore this point any further, I suggest that dialectical process-based approach might go some way resolves these problems, by fundamentally attributing causality to dynamic patterns of organisation, and not to matter itself. Indeed, in such a model matter itself would be defined as a particular kind of process. Evan Thompson has in more recent work made a very similar argument, noting that

> ... 'nature' does not consist of basic particulars, but fields and processes, and this difference between a process-viewpoint and an elementary-particle-version of Cartesian substance metaphysics does make a difference to the philosophical issues about emergence. In the former view, there is no bottom level of basic

> particulars with intrinsic properties that upwardly determines everything else. Everything is process all the way ‘down’ and all the way ‘up’, and processes are irreducibly relational - they exist only in patterns, networks, organisations, configurations, or webs.[113]

In a similar vein, Mark Bickhard follows through to its logical conclusion some of the strongest criticisms of strong emergence (notably from Jaegwon Kim), demolishing both reductive and non-reductive physicalism on route. Bickhard too proposes a process-based metaphysics solution to emergence, suggesting that “grasping why physicalism is untenable ... opens the logical space for a fecund notion of genuine emergence.”[114] In the conclusion to this thesis, I will return to some of these questions, suggesting a pattern-process approach to thinking about matter and organisation, and will consider why this matters to the patterns that connect architecture and ecological consciousness.

5.10 Ecologies of Extended Mind

Surprisingly, perhaps, we have ended up back at the junction of the structuralism/post-structuralism debate, as it was articulated at the intersection of architecture and philosophy in the lat-1980s/ early-90s. Mark Wigley, for example, noted that architecture shares the constructional metaphors and basic building logic of a certain way of thinking philosophically in general (eg. foundation, structure, etc).[115] The cognitive dialectic of organism/environment produces space and time, as abstract conceptual form, and as concrete realities: from the membrane of the cell to the metropolis.

There are a series of routes that open out from the material in this chapter. One route arises from the repeated appeals by thinkers interested in mind embodiment and empathy, a concept which, as will be seen in Chapter Seven, arose historically from concepts in spatial aesthetics, andlater became key to Bateson’s notion of an ecological aesthetics. Another route examines what is known about the neurophenomenology of spatial empathy, and in the next chapter I will therefore explore more specifically what is known about the cognitive mapping of the embodied and extended mind in space. And even more broadly, following the observations of both Thompson and Bickhard regarding emergence, it is worth pointing out that whether one approaches the question from the

point of view of matter (as in Chapter Two), or mind (as here in this chapter), it seems that a dynamic, dialectical vision of systems ecology based on a process-based metaphysics has the most to offer to those of us disturbed by the dualisms and dubious politics associated with particle-based metaphysics of mental and material processes and systems.

6 Bodies and the Timing of Space: The Architecture of Cognitive Mapping

> The objects we perceive in our surroundings – cities, villages, fields, woods – bear the mark of having been worked on by man. It is not only in clothing and appearance, in outward form and emotional make up that men are the products of history. Even the way they see and hear is the inseparable from the social life process, as it has evolved over the millennia. The facts, which our senses present to us, are socially preformed in two ways: through the historical character of the object perceived and through the historical character of the perceiving organ.[1]
> Max Horkheimer

6.1 Mind and Ecology

Despite the increasingly widespread adoption of various conceptions of embodiment across the cognitive sciences, much thinking still seems to default to the habit of assuming a tight correlation between mind and brain – or at least between mind and brain-plus-body. However, as was argued in the previous chapter, mind can surely only make sense when seen as a wider ecological concept. Mind is always composed of loops, relations and processes that integrate an actor and its environment, as subject and object. Mind is always, in this Batesonian sense, fundamentally aesthetic and fundamentally ecological. In the case of human consciousness, these loops necessarily pass through the physiological and neurological processes of the body and brain. However, whilst necessary in this regard, the brain is not alone sufficient for any explanation of consciousness. As Alva Nöe notes:

> ... not only can we not explain mind in terms of brain alone, but we can only explain the brain, and its role in helping give us minds, by thinking of the place of the brain in the context of our interaction with the world.[2]

In this chapter, I will draw together thinking on the relations between an enacted, extended and ecological mind, and the neurology of an embodied brain, with a focus upon our cognitive mapping of our body in space. Understanding the way that the body is mapped as a body, and thus as a body in space, is increasingly seen as vital in grasping how mind and consciousness arise in humans. As far as I am aware, this is the first time that

Cerebral Structures

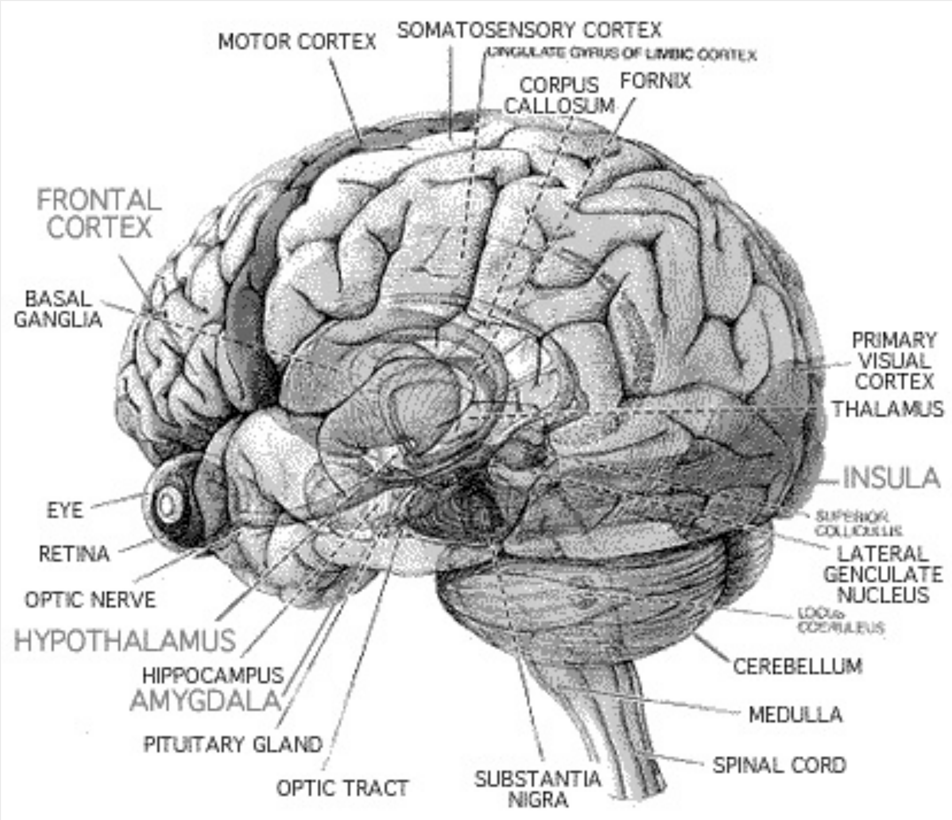


Fig. 6.1 View of internal/surface brain structures. Typically today the structural anatomy of the brain is introduced through a division into cortical and sub-cortical structures. The major sub-cortical nuclei are clustered around the brain stem and below the cortex, and include the thalamus (which is often described as a relay station), and the basal ganglia (typically described as motor-based and action-based), but which also includes the amygdala (generally thought important in decision making and emotion). The hypothalamus regulates homeostatic mechanisms in the body, such as metabolism, food intake, and temperature, whilst the cerebellum, at the back of the brain is closely integrated with the frontal cortex, and is involved in planning and coordinating movements. The hippocampus is generally thought to be involved in spatial and memory processes.

The popular reference to “grey matter” refers to the visual appearance of the neurons on the surface of the cerebral cortex. The white matter beneath the cerebral cortex is made up largely of nerve fibres (i.e. the axon-dendrite connections between the cortex and the lower regions of the brain.) If a section is taken through the brain, the layer of grey matter on the surface is composed of cortex neurons (in total six neurons, or less than 1 cm thick), and the white matter below that is a dense network of connections between these neurons. The characteristic folding pattern of the cortex increases the surface area, which increases the number of cortex neurons that can be located there.

All of the different brain regions are composed of different variations of two particular kinds of specialised cells: the neuron and the glia. There are approximately 100 billion neurons in the human brain, and around ten times as many more glial cells, which support neuronal activity in a variety of ways. A piece of brain the size of a grain of sand contains 100,000 neurons, 2 million axons, and 1 billion synapses. Neurons are cells which conduct electricity in short impulses which can be frequency modulated - thereby encoding information into different firing rates. The neuron can be broken down into a number of elements. The main part of the cell - called the soma - contains the nucleus, and branching off of this are thousands of projections called dendrites and axons. The dendrites bring information in the form of modulated electrical signals into the neuron from other cells, and axons take signals from the neuron to other cell’s dendrites. The bridge between one neuron’s axon and another’s dendrite is called a synapse, and each neuron has between one thousand and ten thousand synaptic connections to other neurons, muscle cells, glands etc. A neuron can be anything from a few millimetres to the full height of the body in length. Bundles of axons and dendrites are referred to as nerves. The various glial (meaning "glue") cells do not transmit electric signals, but rather maintain the neurons.

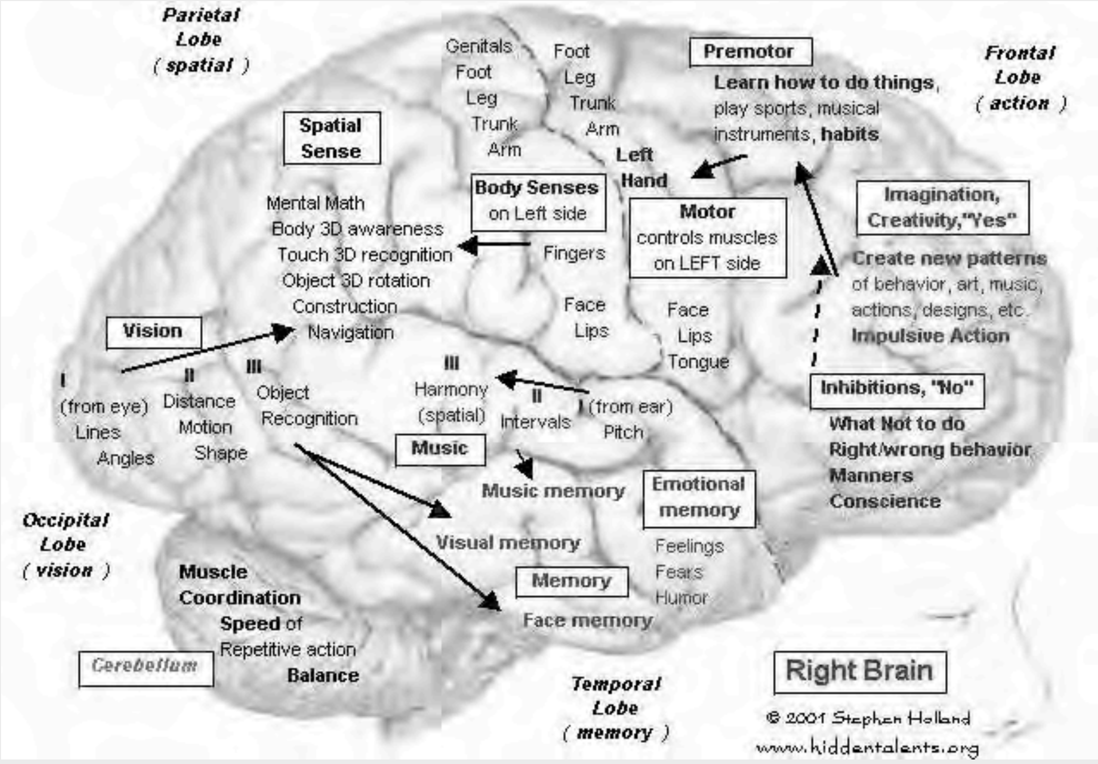
research from so many different areas of neurological and psychological research into how the brain maps space has been drawn together in one place, certainly in relation to architecture and spatial environments.[3] When viewed together, it seems to me that this material makes the embodied account of mind incontrovertible. Furthermore, much of this material also lends support to the the general externalist, extended and ecological approaches to cognition that I have built up over recent chapters. This is perhaps not surprising. An externalist approach to mind might expect to find its clearest support in exploring how it is that the organism describes and defines its external environment.

Whilst this chapter is not in any simplistic way an exercise in neuroaesthetics, there are some interesting readings to be made regarding how we experience architectural form.[4] In particular, I will propose "an affordance based theory of decoration in architecture". However, my primary aim – following on from the last chapter on extended mind, and preceding the next chapter on empathy – is to explore the mechanisms through which our sense of our self emerges from our sensuous and physical engagement with the world.

In the previous chapter we saw many of the problems associated with the idea that minds "compute" on the basis of "representations" of the external word. However, there is clearly representation in some form going on, and understanding what form this takes, and what it means for thinking about architecture in the broadest sense is a key aim of this chapter. Above all, the attempt to define an architecture of mind – i.e. the claims that we can legitimately make concerning our minds, bodies and environments – is not an abstract and neutral scientific or philosophical endeavour, but always a live political project; it is a way of making claims about who and what we are, individually and collectively.

6.2 The Architecture of the Brain

The possession of a nervous system is common to all multi-cellular creatures.[5] The brain – which together with the spinal cord is conventionally described as constituting the human central nervous system (CNS) – is not necessarily best considered as one organ at all, but is rather more like a network of nuclei or sub-brains. Furthermore, our central nervous system is itself inseparable from the physical human body, which is itself



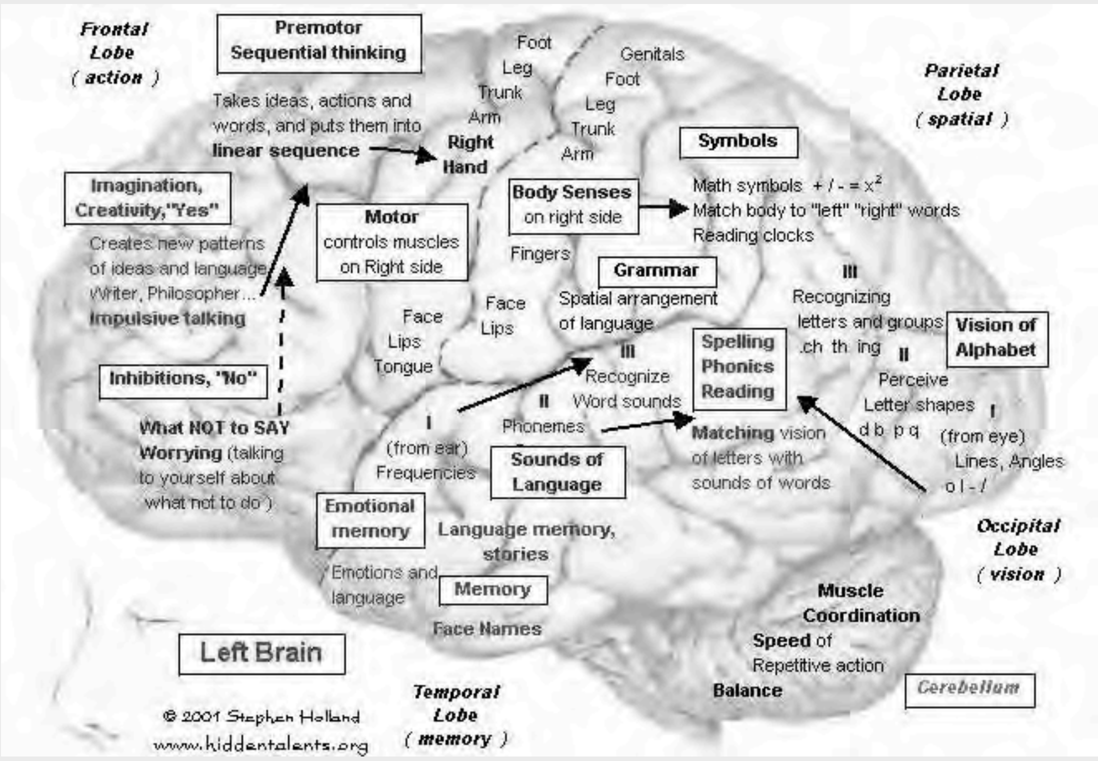


Figure 6.2 and 6.3 Left and Right functional elevations of brain (to be interpreted with caution).

inseparable from its broader physical and social milieu. Before considering the interrelation between the brain and the environment through various forms of spatial practice, and cognitive mapping processes, it is useful to briefly lay out some of the basic concepts and terms that are used to describe and think about the human nervous system.

The network of brain regions that make up our human nervous system can partly be understood as the result of our evolutionary history, in that there is – according to one simplified interpretation at least – a layering to the brain network: the archaeology of our phylogenetic trajectory. The oldest brain in our head is, according to this account, a fish-reptile brain, which is located at the top of our spinal column. Built over that is the mammal brain. And finally, on top and in front, is the primate brain, the cortex, of which the largest version is that of humans. The most widely disseminated version of this interpretation was popularised by Carl Sagan as “the triune brain”, which he described as being composed of the reptilian complex, the limbic system, and the neocortex.[6] The triune brain was seen as the neuronal analogue to the broader conception of “ontogeny recapitulate phylogeny” – which (although broadly refuted in its original form) interprets the embryo’s development as a series of stages that seem to retrace the historical lineage of the species.

The concept of the triune brain is clearly an oversimplification,[7] and recent studies suggest that brain evolution is not in any way a simple additive process. There has been a highly plastic series of reorganisations of a whole series of sub-components of our inherited reptile and mammal brains – some were grown, others were cross-connected, allowing latent potentials that can be found present much lower down in the phylogenetic tree to become dominant, and so on. These sub-components of the compound brain, called nuclei, are cross-connected or networked together, and networked back to the cortex, in ways that are specific to humans. Nonetheless, the triune brain is still a useful way to start to think about the organ – as a network of sub-brains, each of which has a distinct evolutionary history.[8]

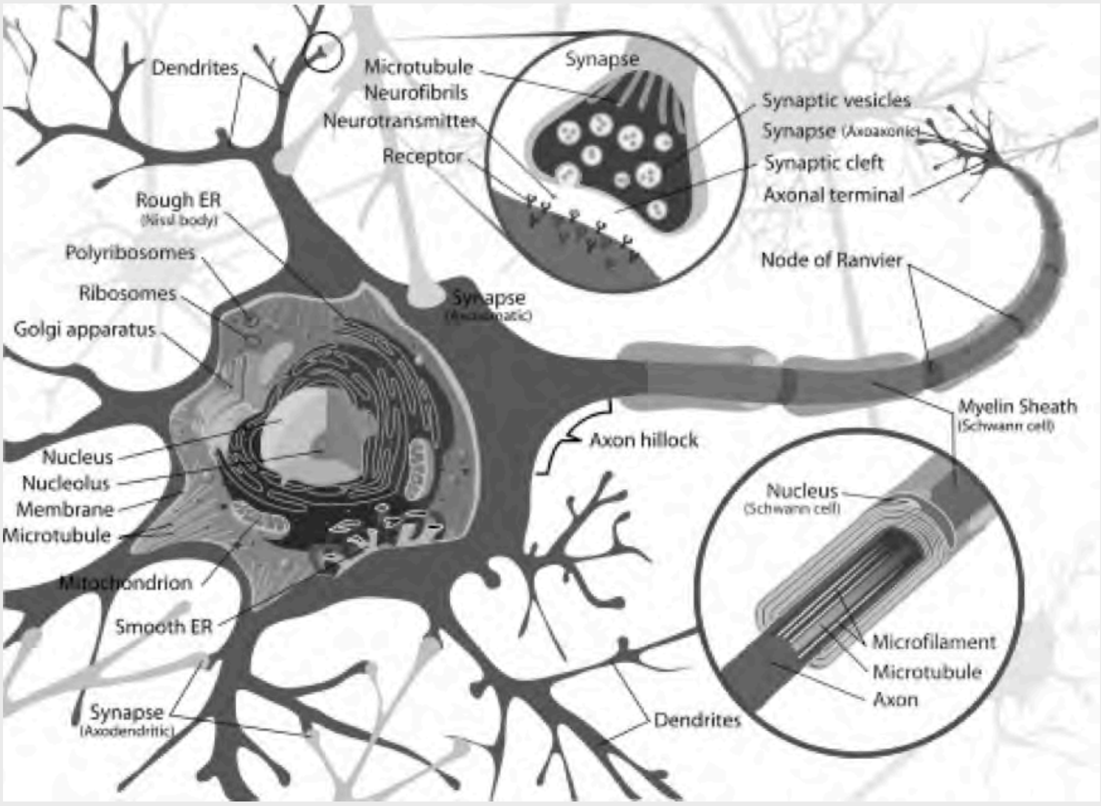


Figure 6.4 Diagram of the architecture of the neuron.

Seth Grant is a leading researcher involved in the proteomics of the synapse: the study of groups of proteins associated with synapses across different species (synapses being the connecting mechanism between neurons). Specifically, Grant has been researching the evolution of the synapse between species, and the results are interesting in regard to cybernetic arguments. Grant looked at a range of different organisms, including vertebrates, invertebrates and also single-cell organisms that do not have nervous systems, such as yeast. The results have suggested that “there appears to be a very interesting connection between the molecular complexity of synapses, and the anatomical complexity of big-brained mammals such as ourselves.” (Seth Grant in conversation with Ginger Campbell, accessed from http://docartemis.com/brain%20science/51-brainscience-Grant.pdf)

Intriguingly, these findings support the the work of Maturana and Varela regarding cognition. Grant has found that 25% of the proteins that are active in human synapses can be found in yeast. However, yeast do not actually have any synapses, rather these “proteins that are found in unicellular animals are used by those animals in their response to their environment.”

As discussed previously, Maturana and Varela argue that the very act of engaging with an environment, even the simplest chemical response, can itself be considered to be a cognitive act. However, one wonders whether they would have anticipated that literally some of the same chemicals used in this primary cognitive-practical activity have remained central to the cognition of all of the organisms that have evolved, including humans. As Grant points out:

“... what this is telling us is that the very origins of the brain, the evolutionary origins of the brain, are not in animals like jelly fish and other very simple animals with a few neurons in a very simple brain, but the origin of the brain is much earlier than that – it is right back in unicellular animals, and that ancient molecular machinery was allowing that animal to make decisions and respond to its environment.” (Ibid.)

6.3 Embodied Brains

If the brain in our head is actually a network of sub-regions, it is also a part of a larger network of neuronal and nervous tissue running throughout the human body. Our nervous system is not just the network of nerves that sensitise our skin and/or specialise to form our various senses. All of our major organs are sheathed by and interpenetrated with neurons, and as a result each organ should be thought of as also making to the greater brain system. The glandular system also makes a significant contribution to the chemical information flows throughout the nervous system.

Some research suggests that the so-called limbic system, which is widely associated with emotional experiential content, is closely connected to frontal lobes, and it is in part through this connection that emotional content is given a rationality, thereby allowing the “intelligence” of the limbic system to be incorporated into our “newest” brain. The hypothalamus in the brain is also deeply connected into these systems, and “can be regarded as the ‘brain’ of ... [an] archaic, ancillary nervous system.”[9]

Perhaps most intriguing and important of all – given widespread folk beliefs throughout history in the cognitive role of the heart – is the fact that the heart is the only organ apart from the brain that is primarily composed of neurons.[10] The neurons in the heart are of a specialised kind, with heightened electromagnetic sensitivity and function. Heart cells collectively self-organise in order to transmit beats of electric pulses through their structure, in order to pump blood around the body. In fact, heart cells grown in a petri dish will spontaneously start to beat in unison.

Although there remains much work to be done in understanding exactly what this neurocardiological system is, and how it should be thought about, some argue that the “brain of the heart” is an independent cognitive system with its own independent autonomic nervous system running through the body, and which proactively interacts with the brain in the head in ways that facilitate or inhibit cognition, perception, and decision making processes based there.[11] In addition to direct neural connections, the heart communicates with the main brain, and thus the rest of the body, through biochemical (hormones and neurotransmitters)[12] and biophysical (pressure waves) means – and some suggest, through electromagnetic fields.[13]

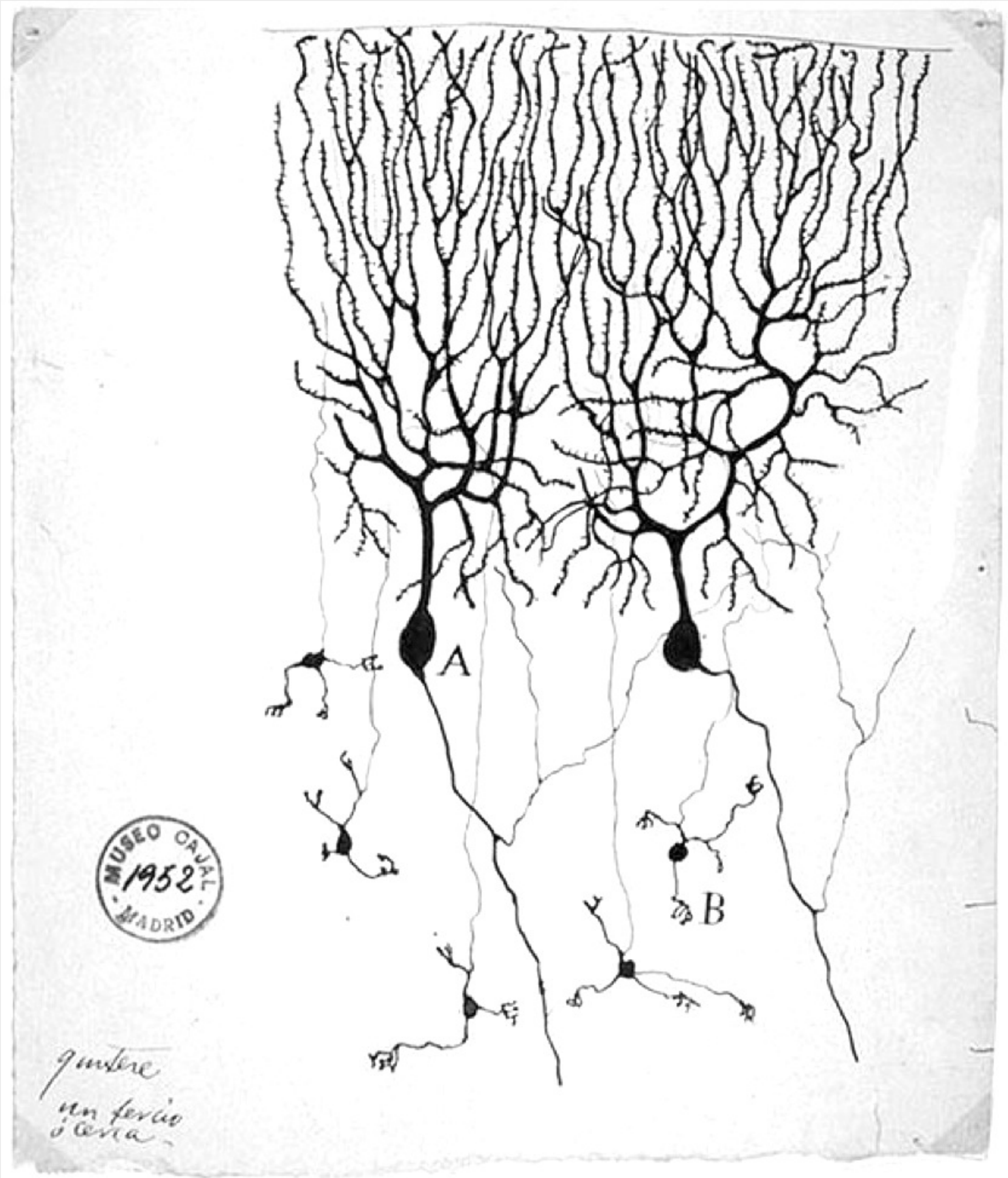


Figure 6.5 Drawing of Purkinje cells (A) and granule cells (B) from pigeon cerebellum by Santiago Ramón y Cajal (1899). There are different types of neurons. They all carry electro-chemical nerve signals, but differ in structure (the number of processes, or axons, emanating from the cell body) and are found in different parts of the body. Sensory neurons or bipolar neurons carry messages from the body's sense receptors (eyes, ears, etc.) to the CNS. Motoneurons or multipolar neurons carry signals from the CNS to the muscles and glands. These neurons have many processes originating from the cell body. Interneurons or pseudopolare cells form all the neural wiring within the CNS. These have two axons (instead of an axon and a dendrite). One axon communicates with the spinal cord; one with either the skin or muscle.

Neurons are either on or off, excitatory or inhibitory, and the number of possible brain states – that is to say, the number of distinct permutations of combinations of connections between neurons, etc – is greater than the number of elementary particles in the universe! Whilst the primary means of communication within neurons is electrical; with signals travelling at 200 mph, there are also a significant and wide variety of chemical signals, constituting communicative systems that operate at a variety of speeds through the body. Whilst the transmission of data across synapses is usually mediated by chemical signals, there are also other chemical signals in constant flow, from for example the nervous systems interconnection with the glandular network, through which information is processed at very different speeds.

Although there are only 40,000 neurons in the heart, this is similar to some nuclei, although numerically small compared to the total number of neurons in the main brain. However, the majority of the specialist neurons in the heart, which are called sensory neurites, have a distinctive electro-magnetic function, and create an electromagnetic field which is around five hundred times stronger than that of the brain in the head, and which can even be detected several feet away from the body.[14]

There are a number of speculative reading that have coalesced around this kind of information. It has, predictably enough, attracted all kinds of New Age interpretations. Equally, it has all kinds of potential attractions to externalist approaches. The kinds of suggestions that are made concerning ‘cognitive’ roles for the heart include the proposition that the electromagnetic field of the heart might act as a rhythmic information carrier wave for all of the cells in the body. Others suggest that this means that the heart is also very sensitive to electromagnetic fields in the environment, and that the heart does in fact create a distinctive electromagnetic field around the body. Some researchers claim that in this way we respond “instinctively” to the fields of other people, animals, and plants, as well as to the fields created by particular landscapes, geologies etc.[15] If there is in fact any basis to the idea that the heart is plays some kind of secondary role as a magnetic field sensor, to what extent the electromagnetic signatures of the stones and services of buildings and cities might contribute, to a deeper level of architectural empathy?[16]

6.4 Cognitive Maps

> A neurologist might conclude that God is a cartographer... for everywhere you look in the brain, maps abound.[17]
> [V.S. Ramachandran]

> Mind is ... influenced by ‘maps’, never by territory, and is therefore limited by the generalisation that its receipt of info will never prove anything about the world or itself.[18]
> [Gregory Bateson]

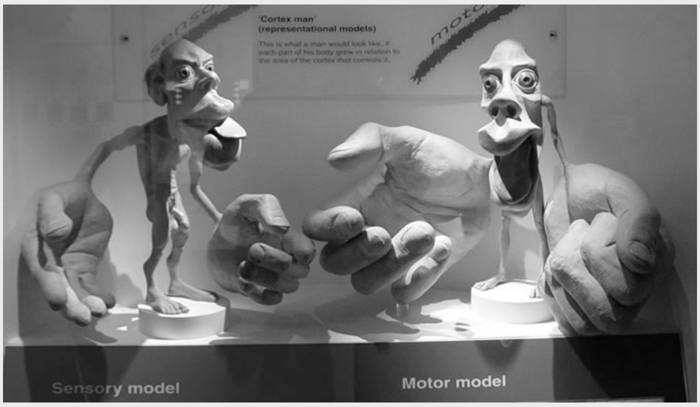
Whatever the ultimate intellectual robustness of some of the more speculative concepts of extended senses (whether based upon morphic, informational or electromagnetic fields), we can be sure that there are real connections between the human organism and its

environments. These are based in the receptors of electromagnetic fields that we know as our eyes, the receptors of auditory fields of vibration that our ears respond to, or of the olfactory fields of the nose, or the haptic fields of our largest organ – the skin. Whilst if the heart does act as a sensory organ for electromagnetic fields of a different wavelength to the eye, and even if the brain is able to pick up on the informational fields that pattern the matter of the rest of the universe, it still does not change the fact that this would just be more sensory information, which still needs to be processed, or given meaning, in the same way as we do with the other more familiar senses.[19]

In previous chapters I have reviewed the cybernetic and constructivist conceptions of the relationship between us as a subject and the external world, which can be summarised through the analogy that the taste of sugar is not in the sugar! To explain, the sugar molecule is not inherently sweet. Sweetness is in fact what some philosophical discourse would describe as a qualia, and is constructed through a particular capacity of an organism such as the human to react with an element of the external world in a systemic feedback loop, thereby connecting a carbohydrate, sensors on the tongue, connections to the brain, and quite possibly a range of other cultural associations connected with wherever the carbohydrate molecules have come from. A similar approach is considered to be true of all internal constructions of external reality. We do not in any simple way directly see or feel the outside world. Nor do we carry around a single “internal representation” that we solely refer to in any simple sense. What we as an organism do is dynamically interact with the world, and the enaction of those process do in some sense constitute maps for processes operating at other “levels”. It is through our interactions with the exterior world, and the maps (or system mirrors) that are produced and that we have access to, which feedback into determining new external interactions. The experience of the sweetness of sugar is then a system, a loop that is both external to the body, constituting one map, but also passing through (and referred to by) other internal maps.

The psychologist E. C. Tolman coined the term “cognitive map” in 1948 to describe an animal's mental representation of space.[20] However, the concept of body schema was previously used by the neurologists Henry Head and Gordon Holmes in 1911 to describe a person’s cognitive maps of their own body (indeed they realised that these schema even

Penfield Sensory and Motor Mappings



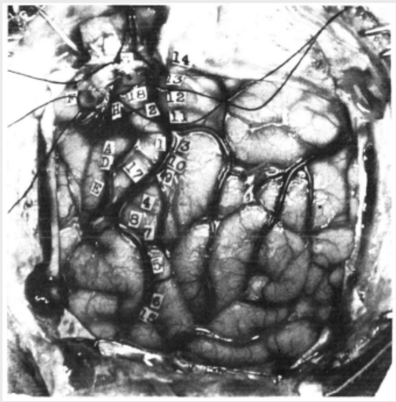
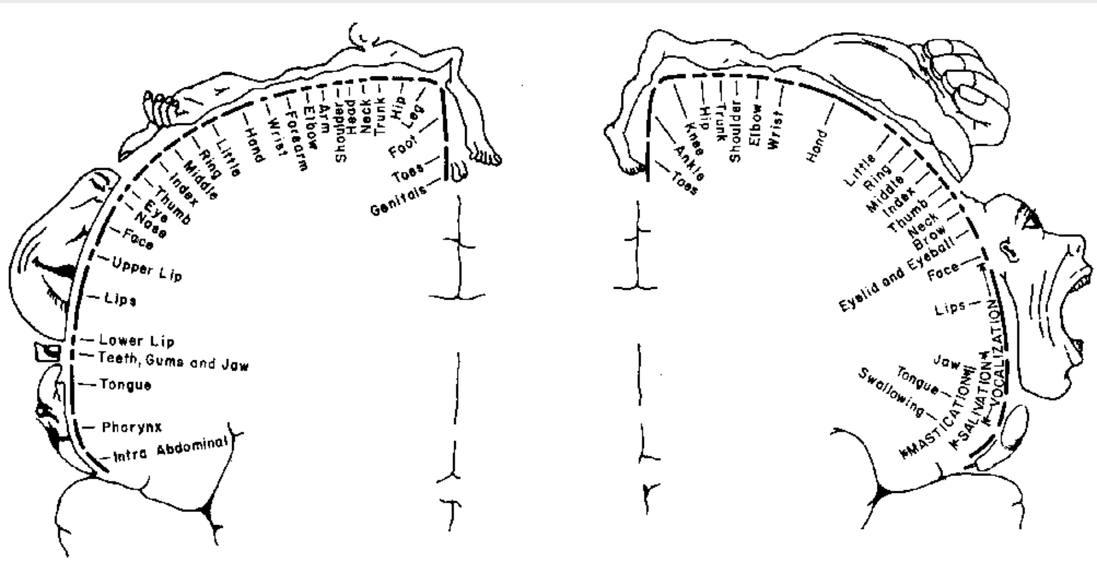


Fig. 6.6. Physical models showing the two Penfield Maps (sensory on left, motor on right).
Fig. 6.7 A photograph of Penfield mapping of a patients brain in progress. Numbers show tested areas
Figs 6.8 The original Penfield mappings, drawn by H.P. Cantilie (sensory on left, motor on right).



changed with whatever clothes were worn). The term “body image” was later added in 1935 by neurologist Paul Schilder.

Since its first use at the interface of psychology and neurology, the concept of cognitive mapping has spread widely.[21] It became an important term in sociology and urbanism, notably in the work of Kevin Lynch during the 1970s, in which Lynch explored the ways that people navigate in cities.[22] Over a decade later, the critical theorist Frederic Jameson took on Lynch’s concept within his discussion of late-modern capitalist culture, suggesting that the processes of mapping oneself spatially and culturally were closely related.

In this chapter I want to review what exactly is meant by cognitive mapping, and what is known about some of the actual processes involved. In fact, I will show that an understanding of the ways that the “brain in the head” maps the “space of the body”, and the body’s parallel interactions with the world, can bring radical insights into our understanding of architecture, and an extended appreciation of the concept of empathy. Empathy hence describes aspects both of the map-making process and the pattern that connects the resultant maps in our mind

6.5 Penfield Maps

In the 1930s and 40s the neurosurgeon Wilder Penfield, working at Montreal Neurological Institute, discovered two maps of the body on the surface of the cortex: the primary sensory and motor areas.[23] Penfield discovered these areas while preparing to operate on epileptic patients – basically using an electrode to explore the surface of the cerebral cortex, to make sure that he did not cut out anything essential. What followed from his studies were the Penfield Maps (made famous by the drawings produced by his assistant H.P. Cantilie) of the sensory homonculus and the motor homonculus, which showed that the amount of brain dedicated to the different parts of the body was not proportional to size, but to use.

Other animals have body maps that correspond to their specific lifeworld. Indeed, looking at the cognitive maps of different animal species emphasises the enormous differences in experience and the different worlds that are in Maturana and Varela’s

Ur-maps in the Cerebellum

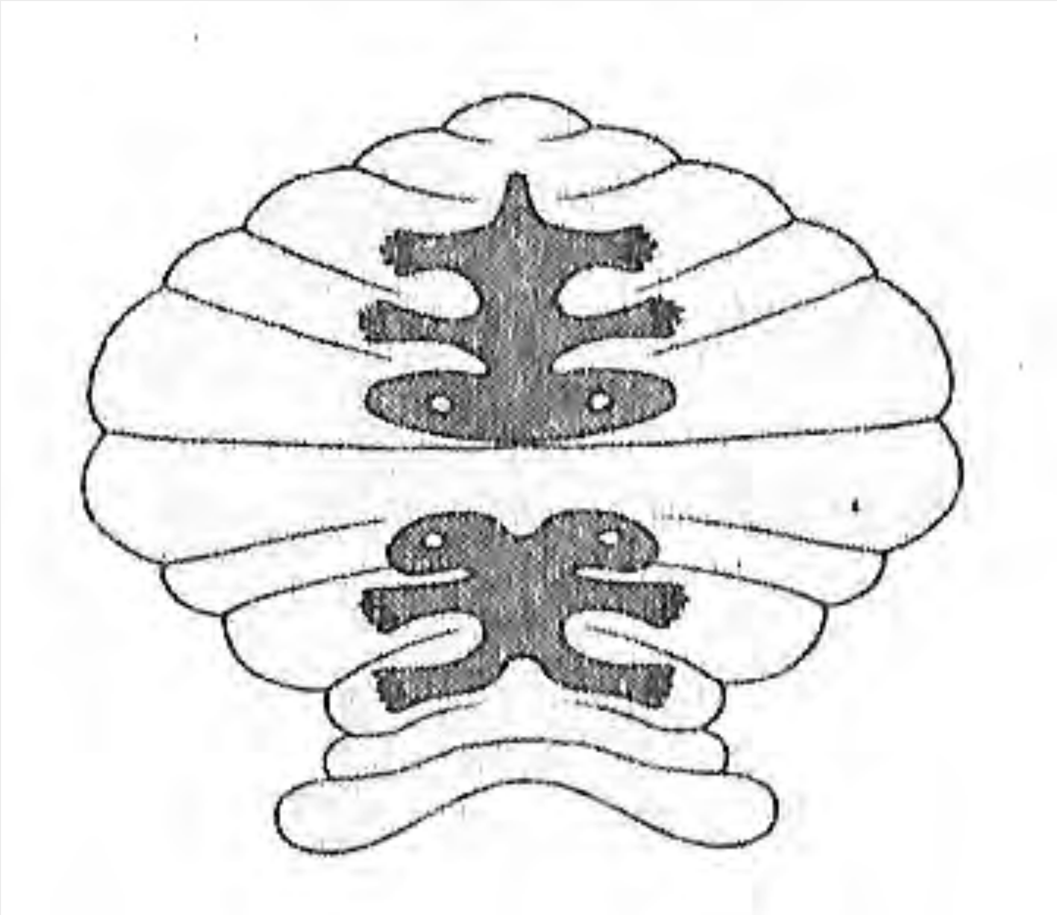


Fig. 6.9. Cognitive maps of the body, found in the cerebellum - perhaps the oldest maps of ourselves that we have.

phrase, “brought forth”. For mammals with whiskers, such as cats and mice, those organs (which of course humans do not have at all) dominate their sensory maps. For the star-nosed mole, the array of feelers that it has for its nose are all-important, apparently to the extent that the layout of the neurology of their sensory maps is visible to the naked eye as a shape on the surface of their cortex. In other animals there are entire senses that we do not have at all: some migratory birds, for example, have visual neurons that have built-in magnetised elements, which means that they literally sense the Earth’s magnetic fields, for use in migration, etc.[24]

In recent years there has been a dramatic increase in the number of cognitive maps that have been found laid out in the human brain. In fact, in addition to the two maps discovered by Penfield in the posterior region of the frontal lobe, there are an additional fifty or more major cognitive maps (and many more secondary ones), all of which have some bearing on how we extend our minds through our bodies and into our environments. All are involved in different ways in making and experiencing the spatial environment around us. A no doubt incomplete list of major cognitive maps includes:

1. touch/somasensory (Penfield)
2. primary motor (Penfield)
3. visceral – interoception (maps of organs, used in emotions)
4. proprioception (musculature etc)
5. secondary somasensory
6. pre-motor cortex - moving intention

7/8. cerebellum

9/10. maps of the body, on the body, such as on ears and feet (i.e. reflexology/ accupuncture maps)

11. peripersonal space -i.e. body coordinate maps (mirror neurons)
12. extrapersonal space parietal lobe (mirror neurons)
13. grid cells in hippocampus
14. place cells in hippocampus

15-45. more than thirty visual maps

Much of this new knowledge of the neurological workings of the human brain and body has in various ways astonishingly confirmed ideas mind and body in the world from very different knowledge areas, such as the phenomenology of aesthetics and philosophy, or eastern philosophy, or the radical constructivist position that emerged from cybernetics. In particular, the work that has developed out of the discovery of mirror neurons has particular interest for any anthropological and ethnographic understanding of empathy theory, since more broadly it suggests some of the ways in which tool use and the practice of building might have played critical roles in the development of human consciousness out of our “mind-at-large.”

In addition to the primary motor cortex found by Penfield, it has since been discovered that the primary somasensory (or touch) map, is in fact four separate maps laid out in close adjacency.[25] Two of these deal with touch, and two with proprioception (the felt sense of limb movements and positions.) There is also a secondary somasensory map which facilitates a greater degree of touch sensitivity. The skin, which as noted is the largest sensory organ, is not merely a touch receptor. There are also “distinct neural pathways that mediate sensations of warmth, cold and pain originate on the skins surface. These sensations have their own ... maps in the brain, but the paths used by them may be interlaced in complicated ways.”[26]

The pre-motor cortex located in the frontal lobe deals with the intention to move our limbs, whereas Penfield’s primary motor cortex is of course involved in the actual movement of limbs. There are maps charting the various muscles and joints, as well as a set of visceral maps. The visceral maps are an anatomical mapping present to a lesser degree in some primates, but are absent in almost all other animals; they represent the heart, lungs, liver, colon, rectum, stomach and other internal organs in the right frontal insula, and are the neural correlates of the sheaves of neurons that surround our organs (as previously mentioned).[27] Through this visceral network we are able to map interoception, the internal state of our body, which through some complex relationship to the autonomic and other secondary nervous systems mentioned above, provides us with a distinct sense of rationality on the basis of social emotions.[28] In addition to these cortical maps, there are two very old maps of the body that have recently been found in a completely different brain region, the cerebellum. The cerebellum is one of the oldest

Bringing Forth their World: The Very Other Sensori-Motor Maps of Non-Human Species.

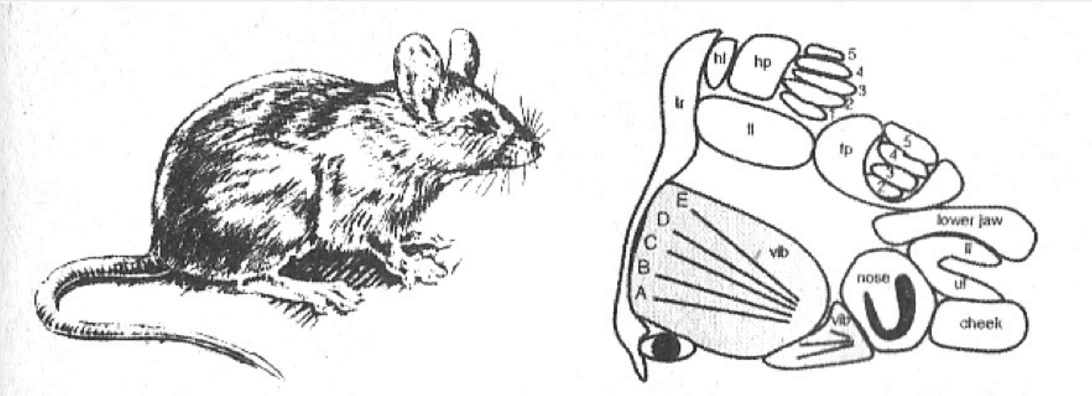
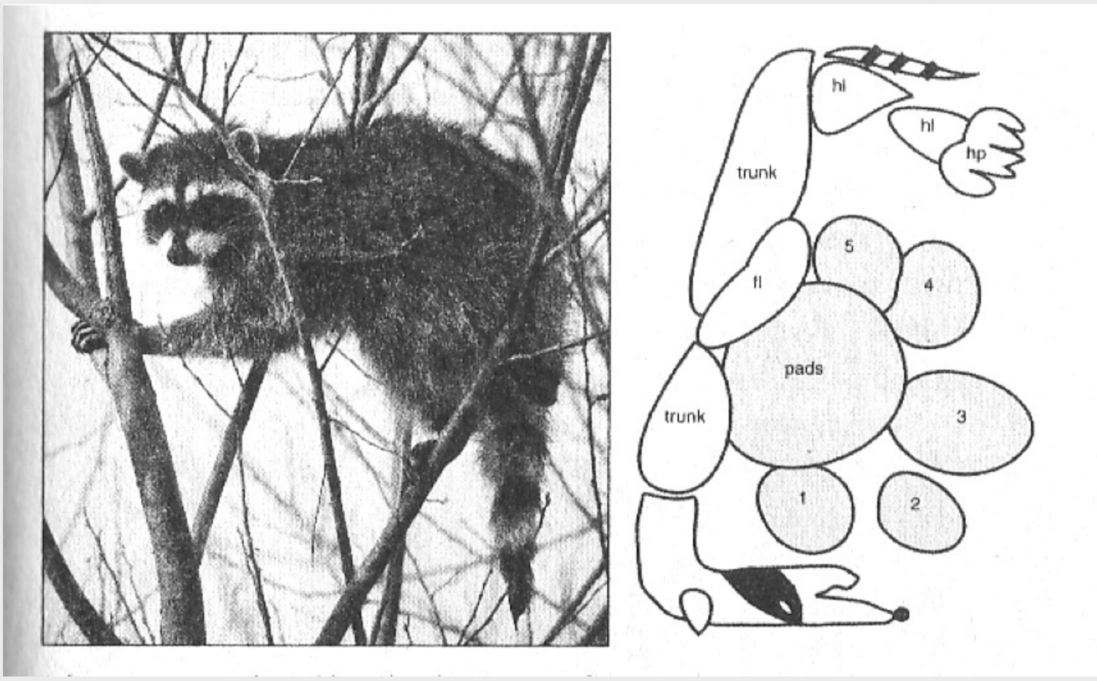


Fig. 6.10 Diagram of mouse sensory map, which is dominated by the whiskers (A-E) and paws.
Fig. 6.11 Diagram of racoon sensory map, which is dominated by paws.



parts of the vertebrate brain, but which nonetheless contains half of the neurons in the brain. These maps in the cerebellum create in my view an extraordinary figural gestalt, an almost a Goethean archetype of humans as ur-animal!

6.6 Visual and Kinaesthetic Maps

There is, then, as we have already seen in the brief survey above, a complex network of cognitive maps related to the human body. In addition to these, which I will return to again later, there are said to be at least 30 major maps related to vision – mostly located in the temporal lobes (located below the temples).[29] The workings of the visual mapping in the brain is both complex and contested. This is not least because we are actually concerned with two different questions when considering vision. Firstly, there is the processing of optical information from our eyes. But there is also the issue of *constructing* what we experience as vision, which is a very different thing indeed. The visual psychologist Beau Lotto in particular has demonstrated – in a series of live participation-experiment lectures and projects developed by his research laboratory Lotto Lab at UCL – that our actual experience and our visual perception are produced and systemically structured in ways that do not correspond to what might be imagined would be the characteristics of an simple and linear mechanical representation. Our perception and experience are shaped by our expectations in all kinds of ways. If we are waiting for someone dressed in red, then you will *see* more people wearing red. Equally, at a more basic level of perceptual construction, Lotto Lab have demonstrated that our perception of the building blocks of our experience – colours, shapes, distances, duration – are produced in relation to their context and our needs, and can be “deconstructed” through a series of perceptual experiments.

The construction of the experience of vision, in both practical and representational senses, is very closely related to the sense of the moving kinaesthetic body in space. Maps related to our kinaesthetic experience of space and body are thought to be located in the posterior parietal cortex. Blakeslee notes that:

Bringing Forth their World: The Very Other Sensori-Motor Maps of Non-Human Species.

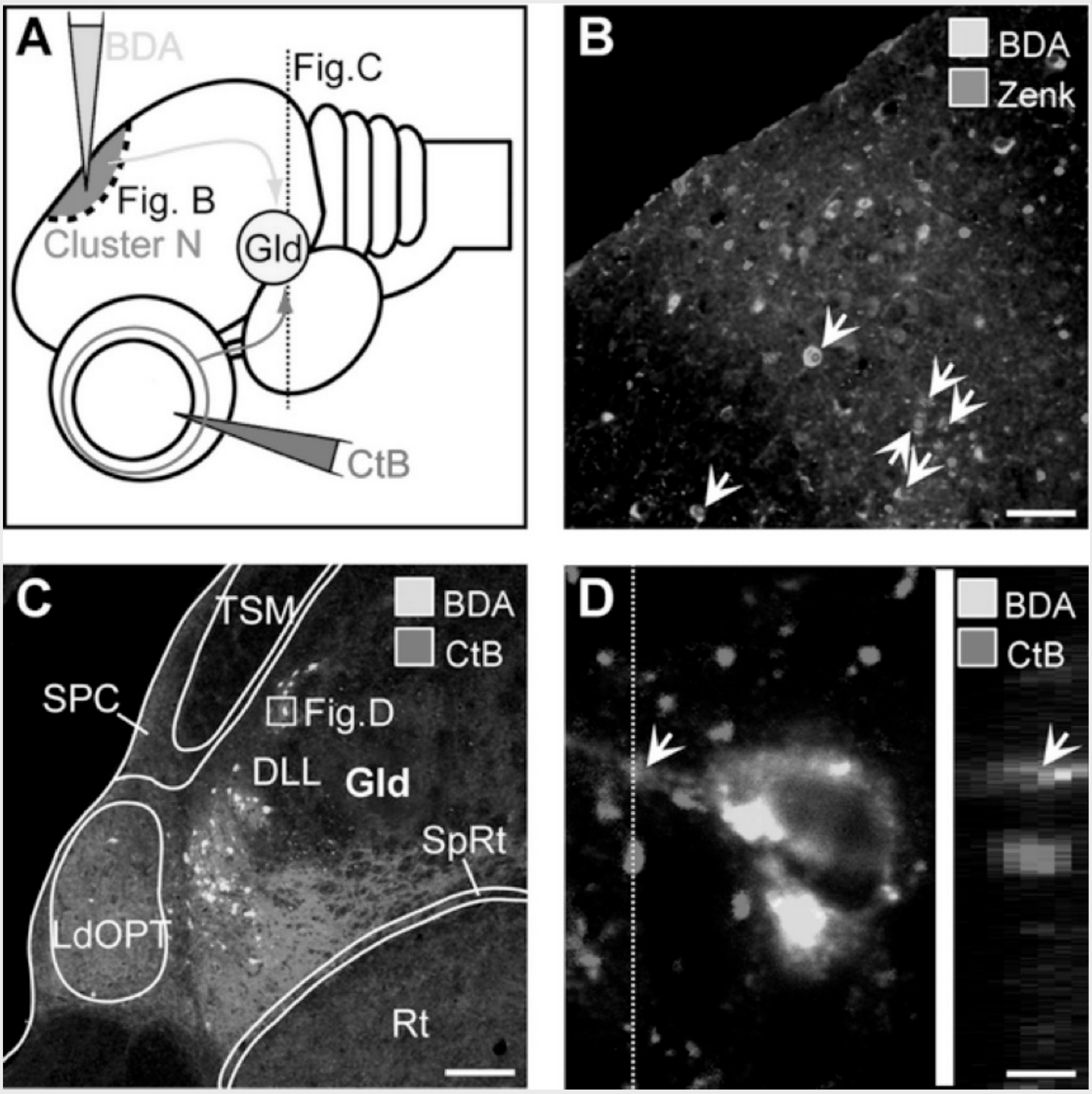


Fig. 6.12 Brain scans of a migratory bird, showing that they have neurons which contain magnetically sensitive molecules to pick up the Earth's magnetic fields. These are fed into the visual cortex, meaning that these birds in some way see the magnetic fields as visual overlays. In all of the above instances it is clear that the animal in question "brings forth" a very different phenomenological world to that of humans.

> ... parietal neurons are not concerned with identifying things in terms of their names, identities, or meanings. Rather, they are concerned with the composition of space and your body's relationship to its surroundings ... some maps 'think' in head and neck centred co-ordinates; some are trunk centred; some are arm and shoulder centred; some are eye-centred; some are hand-centred; some are whole body centred.[30]

Other maps then co-ordinate these maps with the motor maps in a process that, as we shall see, seems to be key to create a unified sense of self. The visual, sensory and motor areas are themselves networked together to form other, second-order maps. But just as importantly, they are networked through our action in the external world. In an important sense this process is the neurological correlate of the mechanisms that extended mind theory in general is concerned with. When you decide to move, this decision is initiated in the pre-motor cortex, and implemented through the motor cortex (i.e. one of the Penfield Maps.) Here is the primary motor cortex which deals with basic movements, and the supplementary motor area, which deals with more complex movement mapping skills. Simultaneously, as the signals are sent to the muscles, other signals are sent back to the cerebellum and parietal lobes. As the muscles then actually start to activate, even more signals are returned from the muscles and joints back to the cerebellum and parietal lobes. Together with the maps produced by visual feedback, a complex cybernetic loop is set up.

However, the visual recognition and motor areas are not simply joined in their end use. They co-evolve, in the development of each organism. Our vision, and that of mammals in general, essentially requires a sensing body in order to correctly develop. Experiments were conducted in 1963 by Richard Held and Alan Hein with two kittens, in which both kittens were held in connected moving baskets, but only one of them was actually in control of moving the baskets. The one which was in control of its movement developed normal vision as it grew up. The other kitten, which experienced exactly the same visual movements, but without any motor feedback – that is to say, without a proper cybernetic extensions of mind – did not develop normal vision.[31] These experiments, and others since, have shown that maps of the body and senses are plastic in the sense that they develop according to experience and sensory input.[32] More significantly, they show

Paul Bach-y-Rita and Sensory Plasticity

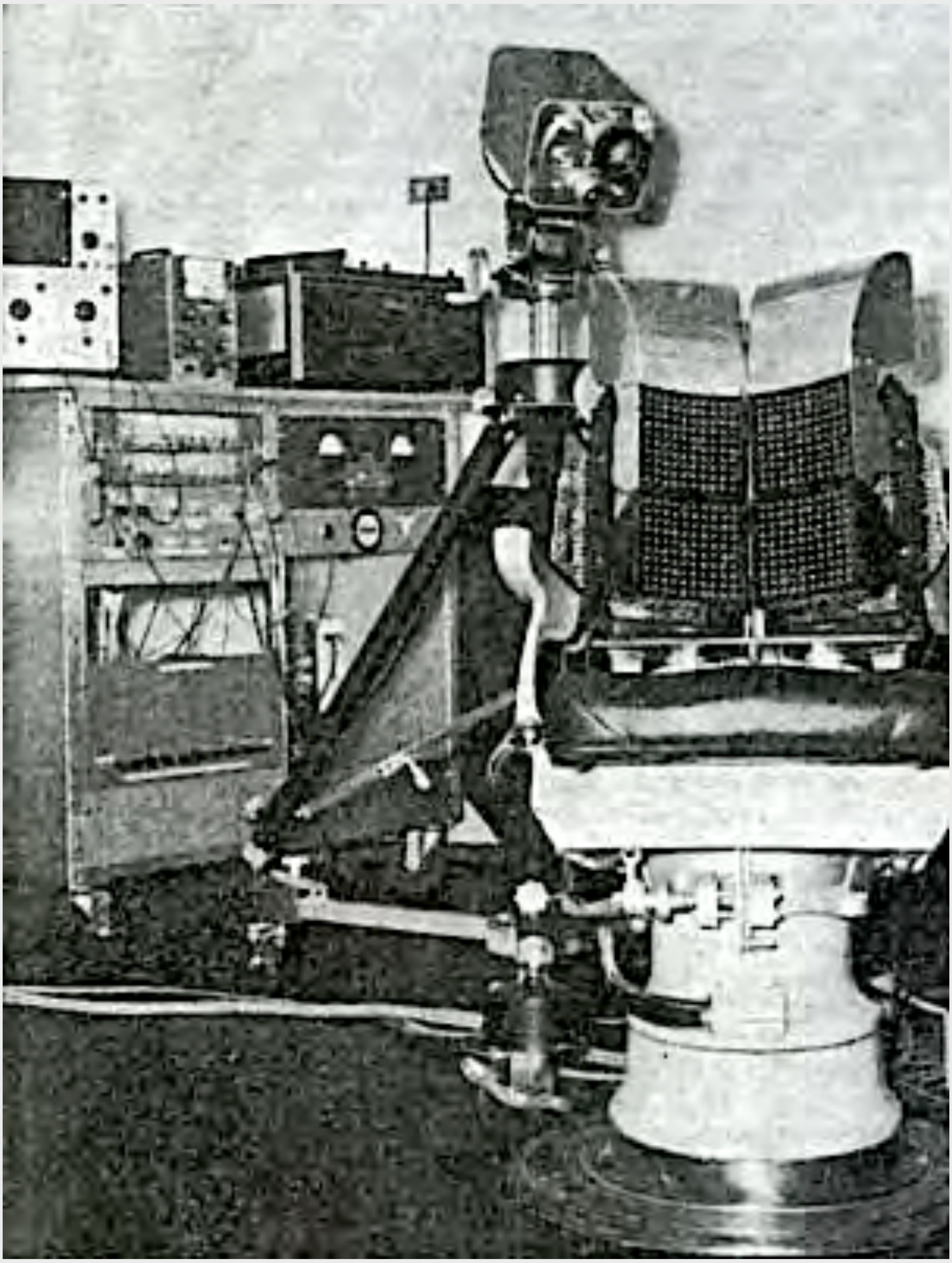


Fig. 6.13 Paul Bach-y-Rita's first experiments concerned feeding visual information from a video camera into touch pads fixed to the back of a dentists chair. Famously, this was ineffective until the subject took the camera in hand – the combination of motor and visual feedback is essential to the construction of a visual field. In more recent work Bach-y-Rita developed a micro sensitive touch pad which is felt on the tongue; this system is now used by deep see underwater divers in low light conditions.

Areas which in normal development might be used for hearing or sight will get used in other ways in people where the hearing or vision senses are in some way damaged. The brain in general is, then, according to much contemporary work, highly plastic. Richard Gregory defines plasticity in the following way: "Plasticity in the nervous system means an alteration in structure or function brought about by development or experience. But not just any alteration, to qualify for term plasticity, an alteration has to show pattern or order. Plasticity here means patterned alteration of organization." Richard L. Gregory, *The Oxford Companion to The Mind* (Oxford: OUP, 1998) p.623.

that the very formation of the senses requires an active body, and that the maps of the senses are not an additional representational add-on, but are a key part of the circuit. Of course, philosophers and artists who have reflected rigorously upon these questions in relation to their own experience have long known this to be the case. Whilst mechanistic and reductive approaches to the brain sciences had tended to try to define particular functions in particular areas of the brain, contemporary research tends to make it clear that that is only part of the story. The brain actually works as a network, with complexity arising through the assembled interactions of different areas of the body. Our visual perception of space is entirely dependent upon our ability to actively move in space. Again, this is an instance of science supporting the previous insights of artists and philosophers. For example, the neurological schema outlined above corresponds to what the Marxian philosopher Henri Lefebvre referred to as our representational space and our spatial practices (as referred to in Chapter One).[33]

The maps of the body also feedback information between the senses, the environment, and the physical structure and organisation of the brain, and the whole bodily circuit is required for the senses to work. As Giacomo Rizzolatti, the leader of the team of neurologists that discovered mirror neurons, puts it:

> ... these acts [moving our arms, hands, etc], insofar as they are goal-oriented and not merely movements, provide the basis of our experience of our surroundings and endow objects with the immediate meaning they hold for us. That rigid divide between perceptive, motor, and cognitive processes is to a great extent artificial; not only does perception appear to be embedded in the dynamics of action, becoming much more composite than used to be thought in the past, but the acting brain is also and above all a brain that understands ... this is a pragmatic, pre-conceptual and pre-linguistic form of understanding, but is no less important for that, because it lies at the base of many of our celebrated cognitive abilities.[34]

6.7 The Mind's I

The U.S.-based Indian scientist, V.S. Ramachandran has noted in regard to the existence of various kinds of vision maps – but these comments are equally applicable to all the senses – that "the mere existence of this map does not explain seeing, for ... there is no

Paul Bach-y-Rita and Sensory Plasticity

Fig. 6.14-15 Paul Bach-y-Rita

Jeff Hawkins argues that the plasticity displayed by the cortex under conditions explored by Bach-y-Rita, and which are demonstrated in all kinds of traumatic or other conditions where normally visual areas are used for tactile senses, suggest that the the division of the cortex into functional areas is in some sense misplaced. Hawkins argues that “cortex is cortex”, and is primarily concerned with pattern recognition, from any source. In fact he suggests that the cortex will “look for patterns in whatever is available” and that its is programmed through “exposure to patterns in the world through your senses.”[109]

Hawkins suggests that our appreciation of music is in fact key evidence for the pattern recognition structures of the brain: “You could take an easy example of a pattern that exists in time like a melody. You can't recognize a melody by hearing one note. You have to hear it through time. You can only make a prediction like ‘what's the next note I'm going to hear in the melody’ if you've been exposed and remembered how patterns move through time- how the notes move through time. So one of the key elements of this theory- the memory-predictions framework- is that the brain is storing in sequences of patterns. You can think of them like little songs, like little melodies, but we do it not just for auditory. We do it for vision and we do it for tactile. So now the sensory inputs as well. There's a theory about how memories are formed by storing sequences of patterns through time in a hierarchical memory structure.”

little man inside watching what is displayed on the primary visual cortex."[35] This statement, an assertion of what is known as the "homunculus fallacy", is familiar from the broader philosophy of mind. The homunculus fallacy effectively dismisses a whole series of models of mind, because they rely upon a model of representation which merely displaces the problem of consciousness deeper into the mind, by imagining another mind (an homunculus) that is observing the representational screen of the first. An infinite regression is suggested of which one can only asks: "how is the mind of *that* internal homunculus working – is there another homunculus inside observing that?"

Whilst I would of course agree with this critique of simplistic representation-based models of mind, the problem is not as easily dismissed as the "homunculus fallacy" argument suggests. Indeed, according to Ramachandran's own insights, there *is* in some sense an internal homunculus, in the form of other internal maps. In fact, one might refute the "homunculus fallacy" argument to some extent by arguing that the mind is indeed something like a *network of homunculi*. This in fact, amounts to an approximation of Marvin Minski's insight in *The Society of Mind*, by which he proposed that our minds can be understood as an internal society.[36]

Images of infinite regression, or of recursion, remind us of the kinds of conditions conjured by opposing mirrors or by video feedback. As noted in Chapter Four, Douglas Hofstadter in particular argued that self-consciousness might precisely be the kind of recursive loop which is found in feedback systems, and in cybernetics such suggestions are commonplace. There is a curious sense, then, that the infinite regression problem or "homunculus fallacy" might be refuted through cybernetic feedback models. There is not a line of homunculi, but rather a chain or network of homunculi (in the form of cognitive maps), and it is thus this very feedback, with the observed in effect observing the observer, that is in some way responsible for some our experience of self-consciousness.

A recent model of visual information processing, as proposed by Gerald Edelman, suggests that there are multiple feedback loops between visual cognitive maps, and once again we are given a mirror-based description: "the brain's information flow resembles the images in a funhouse full of mirrors, continually reflected back and forth, and continually changed by processes of reflection."[37] Blakeslee also describes this feedback process: "in the cortex, so-called lower areas absorb raw sensory information and pass it over to

Recursive Body Maps?

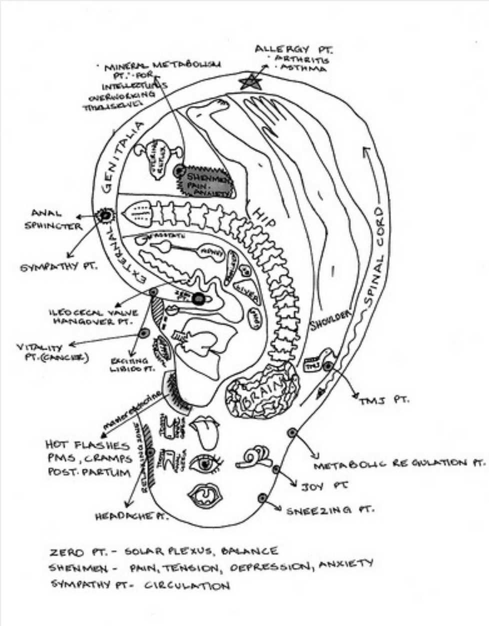
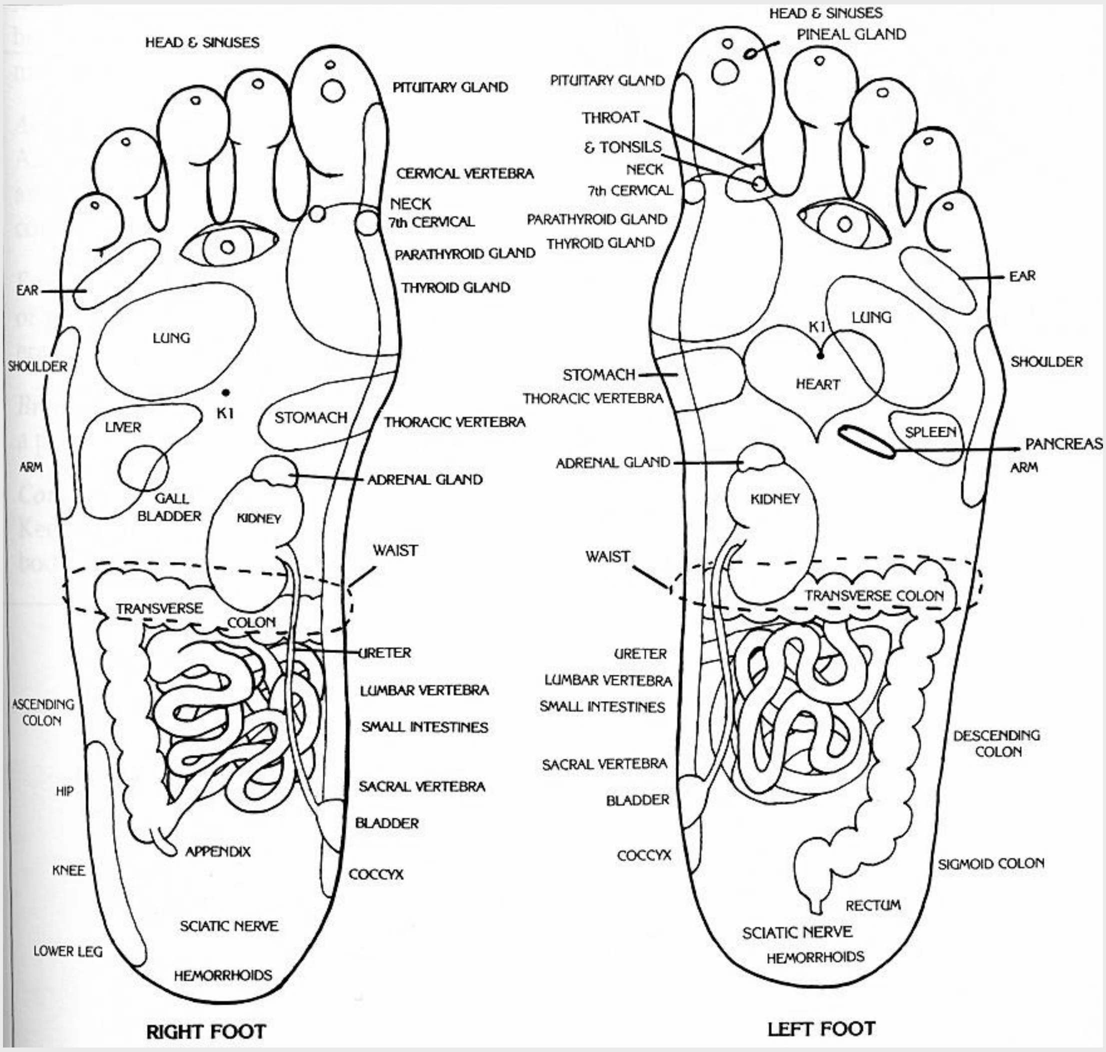


Fig. 6.16 and 6.17 Research is testing the so-called acupuncture and reflexology points on the ear and feet – of Traditional Chinese Medicine – which might be whole body re-mappings that give access to other maps, in ways not dissimilar to the phantom limb remapping discussed below.



higher areas where it is processed and then passed over to still higher areas. But there is no ultimate top area where everything ‘comes together’... once information reaches the higher regions, it is fed back down the hierarchy.”[38] In fact, in most areas “for every fibre carrying information up the hierarchy there are as many as ten fibres carrying processed information back down the hierarchy.”[39] This kind of description of internal processing in humans is of course entirely in line with cybernetic descriptions of mind. Indeed, Blakeslee turns to an entirely second-order cybernetic analysis when she states that “the meaning of this massive feedback architecture” is that:

> ... mind operates via prediction. Perception is not a process of passive absorption, but of active construction.” [40]

6.8 Pathological Mappings

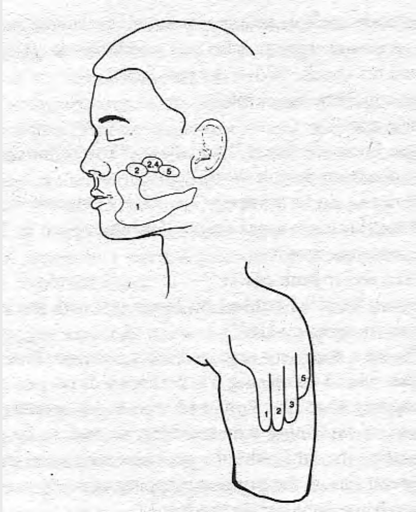
> “There is a pain somewhere in the room ... but I couldn't positively say that I have got it.”[41]
> [Mrs Gradgrind, in Charles Dickens]

The clearest demonstrations of the reality of these multiple body maps, and indeed the clearest suggestions concerning the architectural significance of these maps, often emerge in extreme situations – for example in situations where an individual has had a limb amputated.[42] Phantom limbs sensations have been frequently reported; the individual feels the presence, through pain, movement or paralysis, of a limb that is no longer there. Famously, Lord Nelson lost his arm in an attack on Santa Cruz de Tenerife, and thereafter suffered from phantom limb syndrome, which he took as “direct evidence for the existence of the soul.”[43]

V.S. Ramachandran has led research into this phenomenon, and has shown how in a limb amputation, the relevant map territory of the lost limb can become occupied by other expanding limb maps. In the Penfield Map, the hand and arm area are flanked by that of the face and the shoulder, and sure enough, Ramachandran found the hand to be remapped onto the face in phantom hand cases, and in one patient he also found “a beautifully laid out map of his missing hand tucked onto his left upper arm.”[44] Often what

Recursive Body Maps?

Fig. 6.18 Diagram showing mirror-box experiment by Ramachandran.
Fig. 6.19 Drawing showing typical phantom limb remappings (after Ramachandran).



would happen is that stimulation of the face would directly trigger sensations in the phantom limb.

Ramachandran explored the hypothesis that the syndrome's origins lay in feedback and cognitive mapping issues, rather than being a physical neurological or even spiritual problem.[45] He explored this hypothesis again through the use of mirrors.[46] A box was constructed so that the patient could insert their real hand into one hole, and 'insert' their phantom hand (or partial limb) into another. There was however, a mirror in the box such that, with a bit of adjustment, the reflection of the real hand can be made to align with the felt position of the phantom hand. If the patient now tries to conceptually perform some symmetrical movements, as if conducting an orchestra, such that the moving phantom hand is felt to to in the dynamic position of the seen reflection, then the results it seems could be dramatic. Ramachandran reports that phantom limbs that had been paralysed, or painful, are restored initially to movement, and frequently then disappear after practice. Ramachandran's thesis is that the phantom initially emerges due to the persistence of some cognitive maps of the body (exactly why is not clear). It seems to be resolved through the use of his device, as the visual feedback provided by the mirror box obviously correlates with the persisting map, but after that is not backed up by further feedback from the real muscles, which are of course not there. The inconsistency in the feedback forces another attempt at remapping – this time by eliminating the phantom limb.

However, not all cross body mappings are necessarily unpleasant or pathological. Ramachandran notes that the maps of the feet are next to that of the genitals, and suggests that this is why foot fetishism and sexual sensitivity in feet is so common.[47] Furthermore, in Chinese traditional medicine and reflexology there are thought to be homunculus maps of the body and organs – which are mapped over, in particular, the feet and ears – that are effectively thought of as built in remote control devices to access the maps of the body and its various sub-brains. There is some current research exploring these traditional Chinese conceptions of the body and energy in relation to phantom body cross-mapping.[48]

We do not not necessarily need to use mirrors to explore our cognitive map layouts. We can explore our body image and feedback loops through other analogue mapping techniques. The most common of these is the rubber hand illusion. Basically, it is

How to have an Out-of-Body Experience

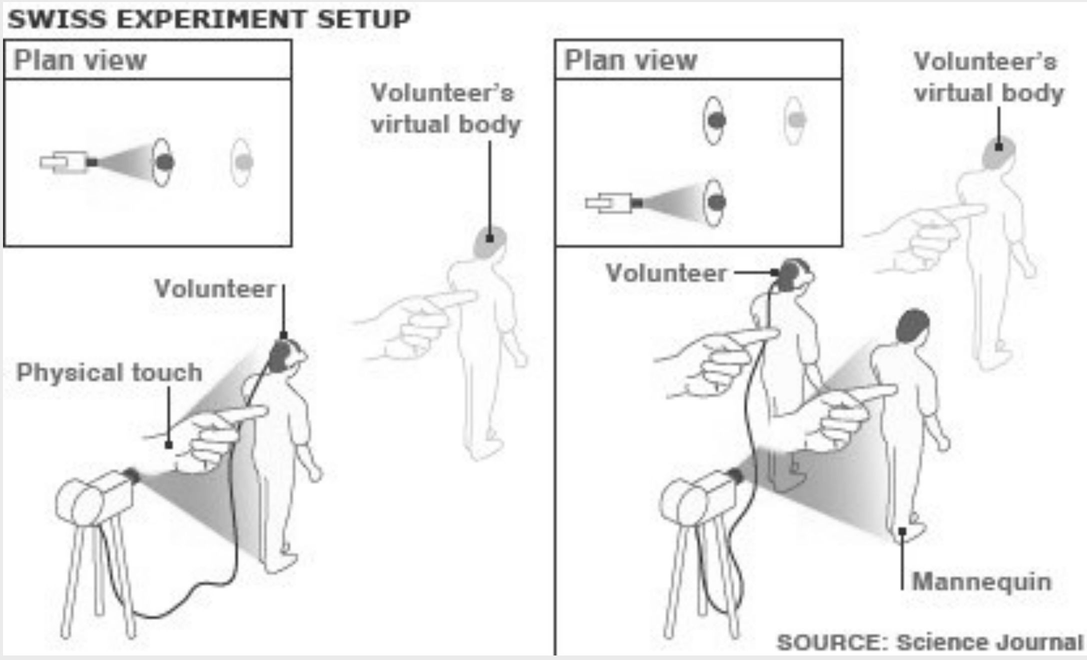
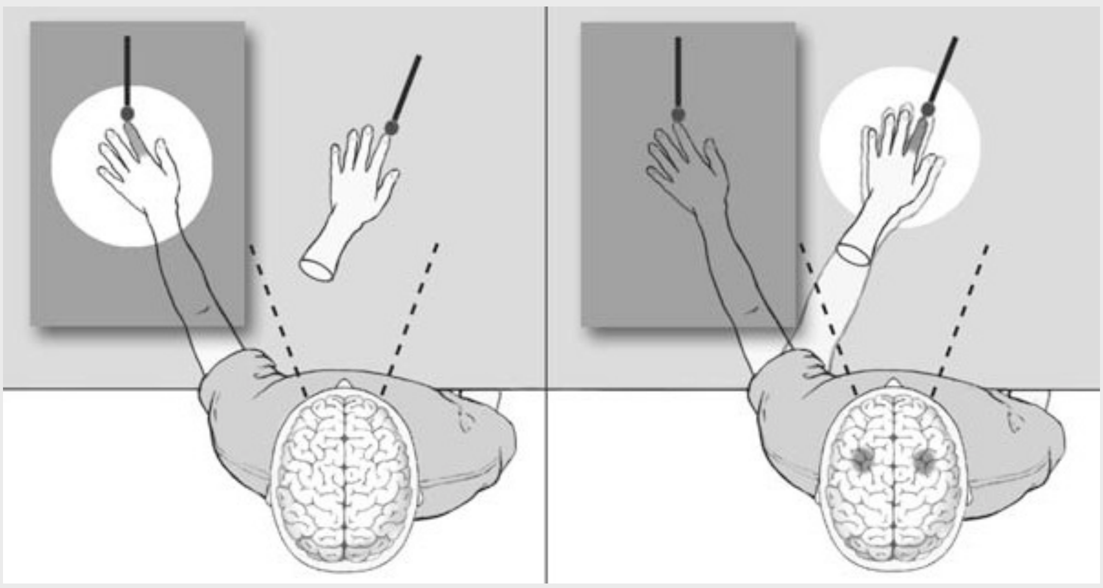


Fig. 6.20 Olaf Blanke lead one of several teams of neuropsychologists (others notably include Henrik Ehrsson's team) which have in various ways explored how it is that we come to have a sense of ownership of a defined body. Blanke's team have, in their case using VR headsets (although other versions of similar experiments can simply use a rubber hand), created OBEs by confusing the cognitive maps (or more precisely, the cross-mapping of visual and motor-maps). It is my assertion that the kinaesthetic experience of architecture - as described by empathy theory – can be understood as a form of out-of-body experience. Describing the experience, Blakeslee states "and so, you see this motion and you feel this motion, and then you leave your body. You move out of your body toward the virtual reality representation of your body. It's a dissociation." My argument in this regard is that this dissociation, or alienation, is closely related to the aesthetic experience of spatial empathy. In fact, in a series of important senses, architecture and urbanism initiate a series of dissociative' experiences.

Fig. 6.21 Rubber hand Illusion set up. The real hand is obscured, but is stroked in a synchronised manner with a visible rubber hand - which is typically incorporated into the body schema.



found that if you place a rubber hand on a table, and place your real hand under the table or otherwise out of your sight, and then have someone simultaneously stroke both your real and rubber hand, you will soon incorporate the rubber hand into your body schema. More complex virtual-reality-based versions of this effect has been produced by Henrik Ehrsson[49] (initially at UCL, now at the Karolinska Institute in Sweden) and Bigna Lenggenhager (at the Ecole Polytechnique in Lausanne). In both these cases, a user wore a VR headset, so they could see an avatar in front of themselves. They were then stroked with a stick along their back, whilst they watched the same happening to the avatar. At a certain point their sense of awareness jumps and they feel like the avatar body is their own.

In fact, as Ramachandran has noted, it is not at all necessary for the object of projection to have an close formal relationship to the form of the hand or body. It is possible to project your sense of your body onto a table or chair through the same technique. He suggests that “the idea that you can actually project your sensations to external objects is radical and reminds me of phenomena such as out of body experiences.”[50] Whilst one can agree that this idea is radical, it is surely a closely related process to the aesthetic concept of spatial and formal empathy, that we are discussing here. I would also agree therefore that this has something to do with reported out-of-body experiences – although one the out-of-body experience that I think that this has most resonance with is architecture.[51]

There is, I will propose over the coming pages, a much more interesting relationship between architecture and space, and a whole range of out-of-body experiences (OBE), than has been appreciated so far. Neurologist Olaf Blanke[52] has induced OBEs in patients by stimulating the right angular gyrus, and Michael Persinger[53] has induced OBEs and a broader range of transcendental experiences with his so-called God Helmet (a transcranial magnetic stimulator.)[54] In both types of experiments it is the area where the temporal and parietal lobes meet (just above your ear) which is found to be the area that maps your body in space. In Blanke’s research (much of which was produced and disseminated with the philosopher Thomas Metzinger), stimulating the right side above the ear caused patients to report suddenly finding themselves floating in the air with their backs pressed against the ceiling.[55] Stimulating the left side caused patients

to report feeling themselves being held by a shadowy figure. Although the patients involved often argue that these experiences are completely “real”, Blanke suggests that these experiences are the result of shifts in and projections of body maps:

> OBEs are related to a failure to integrate multisensory information from one’s own body at the temporo-parietal junction (TPJ). It is argued that this multisensory disintegration at the TPJ leads to the disruption of several phenomenological and cognitive aspects of selfprocessing, causing illusory reduplication, illusory self-location, illusory perspective, and illusory agency that are experienced as an OBE.[56]

Although there remain accounts of OBEs by reliable witnesses that cannot yet be exhaustively accounted for Blanke’s analysis[57], his basic proposition that this phenomenon relates to shifts in the ecology of body and space maps, offers a convincing explanation of, at the very least, some of the mechanisms involved.[58] In the context of both extended mind theories and the aesthetics of empathy, the spatial component of these experiences is obviously critical. Is the fact that people imagine themselves projected onto the ceiling, the architecture, important, or not? Is the fact that the many battlefield or sports field accounts of OBEs adopt an aerial plan view significant, or not?

Ramachandran notes that:

> ... for your entire life you have been walking around assuming that your ‘self’ is anchored to a single body that remains stable and permanent at least until death. Indeed, the ‘loyalty’ of your self to your own body is so axiomatic that you never even pause to think about it, let alone question it. Yet these experiments suggest the exact opposite – that your body image, despite all its appearance of durability, is an entirely transitory internal construct that can be profoundly modified with just a few simple tricks.[59]

It is interesting now to reflect upon these out-of-body experiences in the light of some of the discussion in previous chapters. The fact that our sense of body ownership is so easily adjusted, suggests that it might well vary historically and culturally, as much artistic and even behavioural evidence would suggest. It also means that we should wonder whether we might already in fact be occupying a series of related “out-of-body positions”, and that in some sense, it is the dominance in our modern consciousness of being tightly located

within our bodies alone (rather than experiencing *as our self*, our ecological extension) that requires explanation. This is of course not to say that there are not good reasons why, as individual organisms, we have also to be aware of the physical boundaries of our own "skinbags". Indeed, for Andy Clark:

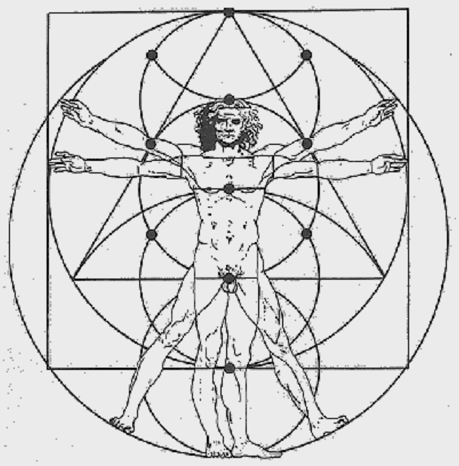
> ... the preconditions for the emergence of a rich sense of self begin to be met, I suspect, when on the basis of such information [sense of location and body boundaries] a loose knit system begins to stabilise itself and to actively protect its own problem solving infrastructure.[60]

Equally, as soon as we recognise the malleability of this sense of bodily ownership, we can start to recognise moments whereby we can identify all kinds of collective experiences as shared and social bodies (from sports to sex to political revolution). It suggests all kinds of possibilities for future, so-called "post-human" developments.

6.9 Peripersonal Space

To briefly recap, then, the idea that there is a straightforward representation of the world in our minds is problematic. Nonetheless, there is still representation of some kind going on: we do not solely use the external world as a "live database", that we access in real-time, whenever we need information about it, or where we are in it.[61] We use maps: lots of them, doing all kinds of things. These maps are then networked together and nested, in many different ways. The maps are mostly found across the cortex, the "newest" region of the human brain. However, there are also maps located in the cerebellum, one of the oldest structures in the brain, plus there are also important spatial maps in the hippocampus. Some of these maps are practically direct and unmediated reflections of our real-time muscular and skeletal activity: information dynamically produced regarding our bodily movements and locations in space. Others are constructed on the basis of sensory interaction with certain environmental domains: i.e. information produced by our senses as they actively participate in the flows of the external world beyond the various "edges" of our bodies. Still other maps are produced by combining in various ways these primary maps. In other words, there is an ecology of maps, a network of feedback loops

Imaging Peripersonal Space



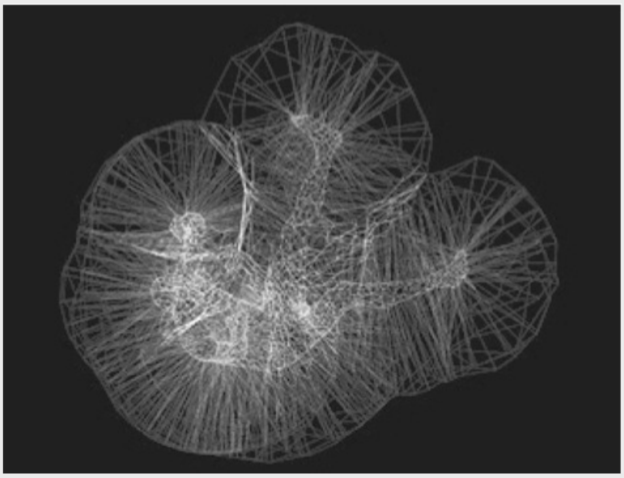
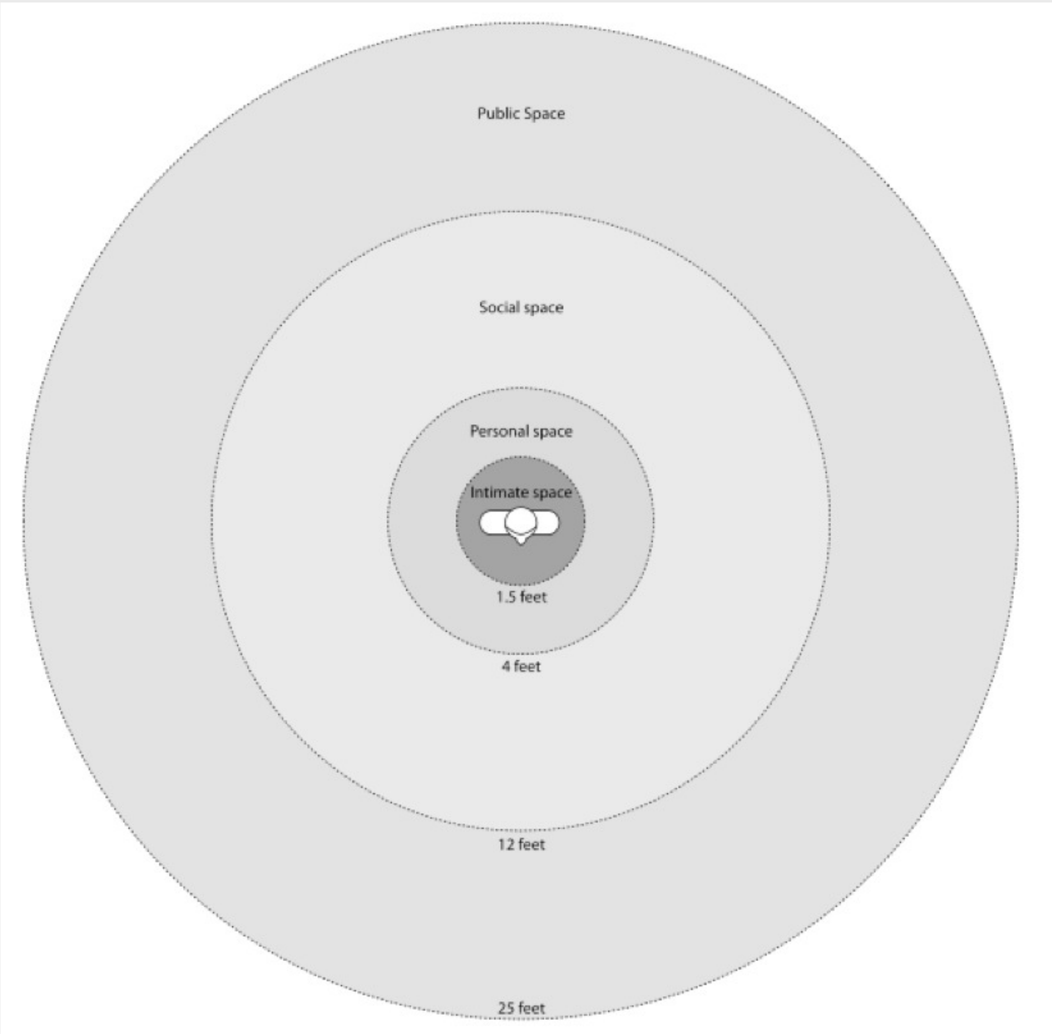


Fig. 6.22. Leonardo da Vinci, The Vitruvian Man (1487) - a map of peripersonal space?.
Fig. 6.23. Anthony Gormley, a mapping of human body and movement zones in space.
Fig. 6.24 A mapping of psychological/defensible space zones around the body (after Alice Coleman): intimate space, personal space, social space, public space.



between the mind, body and external world, and it seems that this ecosystem, as our interface with the broader ecology of minds, is a key component in our experience of consciousness. In a very real sense, it is not simply that we use maps, but that *we are maps*. And maps, as Bateson (drawing upon Alfred Korzybski) emphasised, are always and can only be constructed in relation to experiences of *difference*.[62]

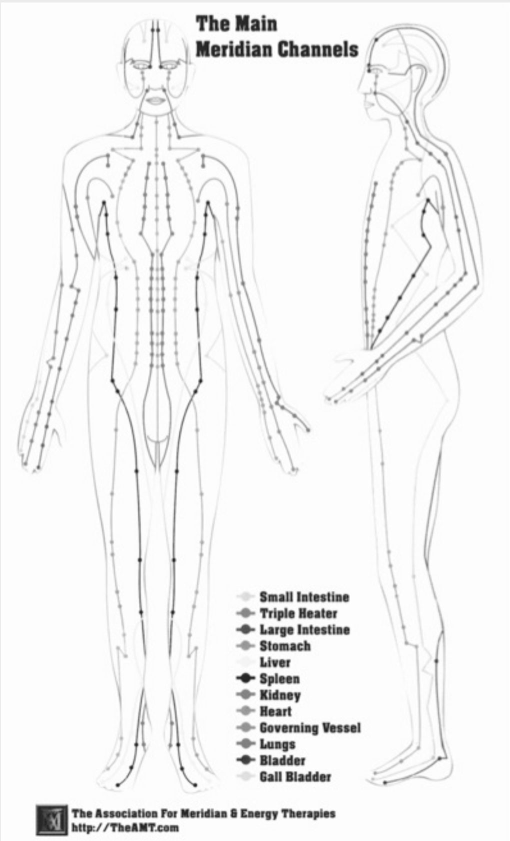
In addition to the maps so far discussed, we also have a complex series of mappings of the *space* beyond our bodies. [63] Our *peripersonal space* is that bubble of space that surround our body, and which is itself mapped through a series of body co-ordinate maps located in the parietal lobe.[64] It is defined by the space that we can reach if we swing our arms and legs around, or bend and twist our torso.[65] It is a dynamic space that shifts and changes as we move around in the world, and interact with other beings.[66] In our brain, this space is mapped out as an extension to the way that our bodies are mapped out. If an object or another person enters this space, neurons mapping that space will fire, just in the same way that neurons will fire if your arm has been touched. It seems that this space is mapped through a combination of visual, auditory, olfactory and various other clues and stimuli. It is not something that we are generally consciously aware of; it has become part of our mind, but not our consciousness:

> ... every point on your body, each internal organ and every point in space out to the ends of your fingertips, is mapped inside your brain. Your ability to sense, move, and act in the physical world arises from a rich network of flexible bodymaps distributed throughout your brain – maps that grow, shrink, and morph to suit your needs.[67]

Peripersonal cognitive maps are the neurological basis of our aesthetic and kinaesthetic sense of prosthetic bodily extension. By picking up a stick that we can swing around, our peripersonal fields extends to map this enlarged space of action. Again, this is no a metaphorical description, nor one that is “only” based upon aesthetic reflection or critical self-analysis; it has been confirmed in the way these neuronal mapping processes are working. When we pick up a stick, are maps of ourselves are literally extended.

Of course, in an important sense, many of these cognitive maps of peripersonal space have been, prior to their recent “re-discovery” by modern science, well established

Esoteric Mappings of Interoceptive, Proprioceptive, Somasensory and Peripersonal spaces



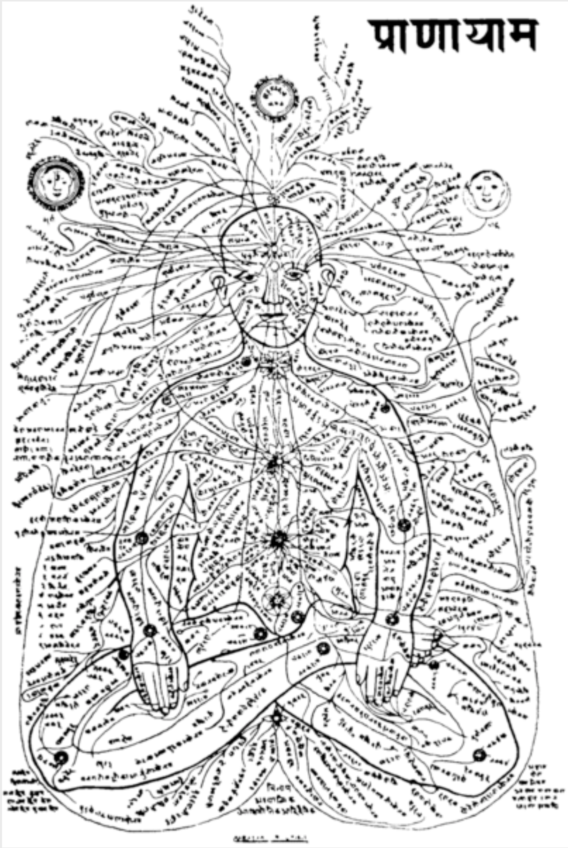


Fig. 6.25-6. Eastern philosophy and medicine in particular has long claimed to have rigourously mapped and manipulated a series of fields surrounding and interpenetrating the body. It seems that if nothing else, these describe the interrelations of the kinds of cognitive maps described in this chapter, and many yogic and martial art practices might be understood as methods for keeping these maps *in form*.

in esoteric literature, being widely documented for instance in the experience of martial arts and yogic practitioners. Blakeslee offers one way to understand this testimony:

> ... peripersonal space is physically, literally mapped in your brain's parietal and frontal lobes. So are your motor intentions within that space. Your sense of owning this space is so real and encompassing that you may feel tempted to feel that you can direct or otherwise manipulate the space as if it had substance or intrinsic energy. This is because your experience is of your brain's representation of that space, rather than the space itself ... because the many maps of the body mandala share information back and forth, these beliefs can even percolate down to the primary touch map and generate phantom sensations – tingles and gentle forces – that the mind interprets as perceptions.[68]

Peripersonal space has been known in western cultures too of course too, and perhaps is even described in Leonardo da Vinci's diagram of *The Vitruvian Man*. There are descriptions in fact from a wide range of cultural humanist sources, most explicitly in modern times for by Henri Poincaré and Maurice Merleau-Ponty, or in the personal space (Proxemics), discussed by Edward T. Halland, or more mundanely in the still popular urbanist conception of "defensible space". Peripersonal space is not simply some loosely defined and imagined approximation, or an effect produced through copied cultural behaviour. It is rather precisely mapped in the brain as an extension of our body, in a way that is not differentiated from the physical body, but is instead defined as the potential space of the body:

> ... the same neuron that discharges when we brush the monkey's arm also becomes active when we move our hand close to the animal's forearm, entering its visual receptive field. If you find this hard to believe, bring your hand close to your cheek: you will feel it before your fingers actually touch the skin. It is almost as if the personal (ie cutaneous) space of your cheek reaches out to embrace the visual space that surrounds it.[69]

The posterior parietal lobe is where a number of feedback loops from both the senses and muscles converge. There are several multimodal[70] maps in this area which combine them; in particular there is an important map in the fold at the rear of the parietal lobe that brings together visual and touch sense loops, and has what is called a bimodal

receptive field – that is, it responds both to actual touch on a given body part and to activity in the space immediately around that body part. This is not to say that it is necessary to call upon the use of “morphic fields” or anything like that. Peripersonal space is mapped and felt either via vision or other senses responding to an object enter the field. As Eric Kandel describes it, “the visual receptive fields of these neurons ... appear to have been transformed from a retinal frame of reference to a reference frame centred on the position of the [relevant limb].”[71] We are needless to say not actually conscious of these processes as processes. However, we use and feel them in our actions at every moment. Indeed it is these processes that form the basis of tool use.

6.10 Tools and the Extensions of Peripersonal Space

> ... the useful object would be the highest achievement, an anthropomorphised 'thing', the reconciliation with objects no longer closed off from humanity and which no longer suffer humiliation at the hands of men... Mankind would no longer suffer from the 'thingly' character of the world, and likewise 'things' would come into their own. Once redeemed from their own 'thingliness', 'things' would find their purpose. But in present society all usefulness is displaced, bewitched.[72]
> [Theodore Adorno]

There is of course a long history of propositions from cultural theory concerning the ways in which tools and environments act as prosthetics, whether as extensions or reformations of the human body, through projection, cognitive mapping, alienation, empathy and so on. Certainly they have been commonplace since the discourse of the empathy theorist Robert Vischer in the mid-nineteenth century. However, there was until recently little opportunity to test whether the notion of prosthetic tools was just a metaphorical description, or whether tools really are incorporated into the cognitive maps of the body and its surrounding peripersonal space, in the sense that we have been discussing. It was only in 1996 that Atsushi Iriki at the RIKEN Institute in Japan[73] started to explore this area, with the help of some macaque monkeys.

The macaque monkeys were trained by Iriki to use a rake to recover fruit. Brain scans showed that once these tools were being used, they were indeed incorporated as extensions of the body. The motor maps that the space of the tool became completely

Extending the Body

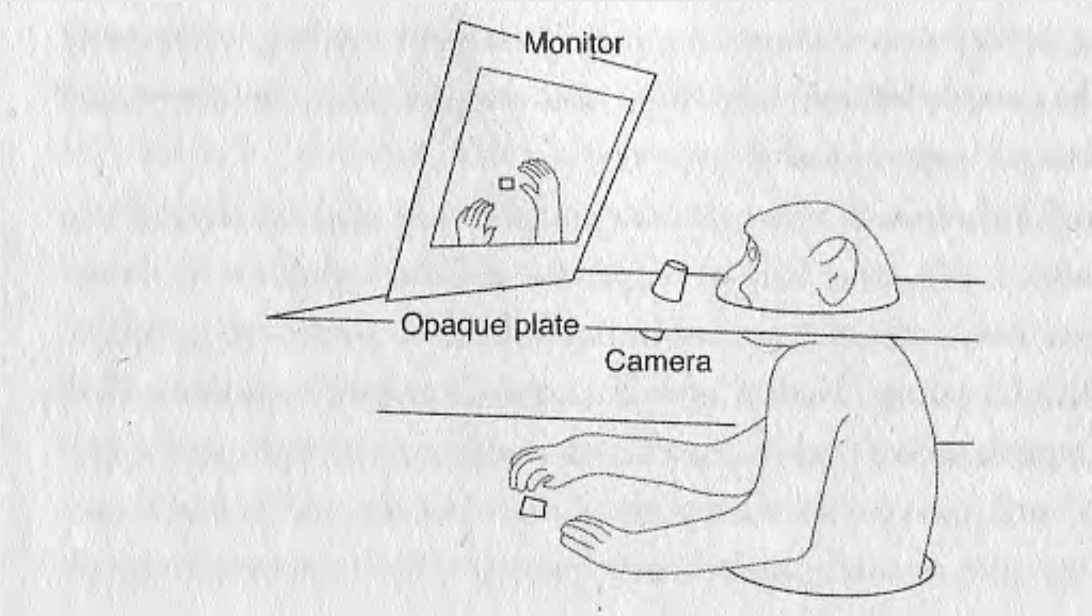
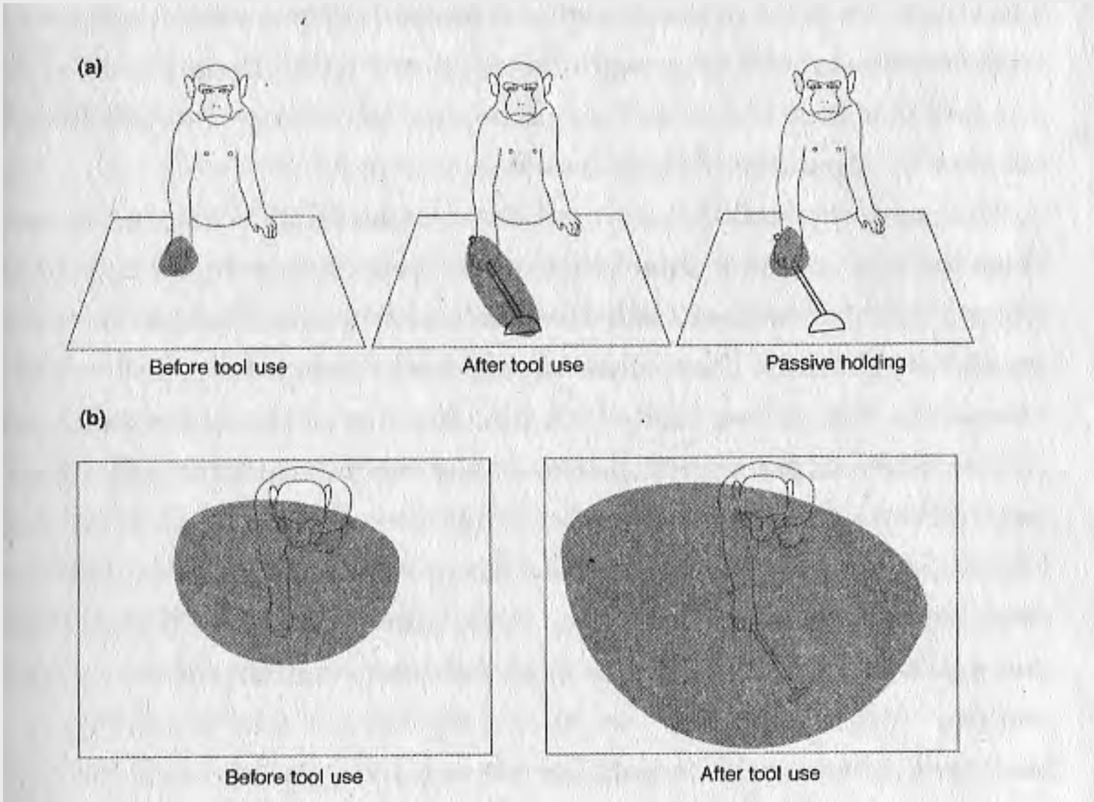


Fig. 6.27-8. Iriki's experiments with macaque monkeys are amongst the clearest demonstrations that, as far as certain cognitive maps in the brain are concerned, tools really do serve to extended the body.



integrated into the map of the monkey's hand when used, and similarly the space described by the moving tool extended the peripersonal space being mapped.

Iriki has engaged the macaque monkeys in an ever more complex series of tool experiments, using mounds, mirrors, rakes of different lengths, video cameras and joystick, and even abstract representations – such as seeing the fruit represented by a white dot, or the rake by a white line, on a video screen. In all cases the monkeys were firstly able to learn how to use the tools to get the fruit, and secondly were shown to extend their cognitive maps in the ways described.

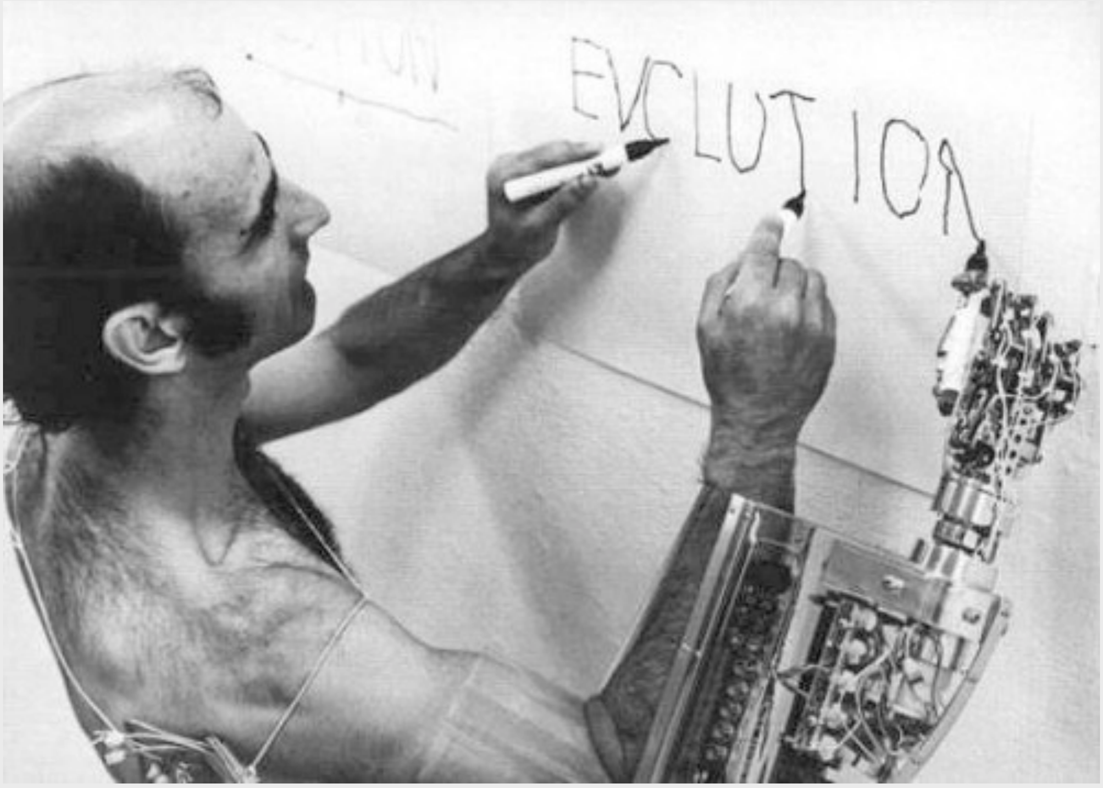
In an analysis of the brains of some of these monkeys, Iriki was able to show that the tool use displayed was not simply a case of "learning" through the use of existing pathways, but was full-blown neural plasticity – i.e. the growth of new pathways. This is why it always took some weeks to train the monkeys to use the tools in question. It is suggested that the kinds of connections between maps that were produced through this new plasticity in the monkeys are already much more present in more evolved apes, and even more interconnected in humans. It is thought that the adoption of an upright gait was the most important change to the plasticity of the brain in humans, in that it massively increased what we could do with our hands, and the mapping of this new activity in turn transformed the human brain.[74]

For Andy Clark, it is this plasticity regarding incorporating tools into the flows of the mind that is at the core of the extended mind thesis. He states that:

> ... advanced biological brains are by nature open-ended opportunistic controllers. Such controllers compute, pretty much on a moment to moment basis, what problem solving resources are readily available and recruit them into our problem solving wholes. Neural plasticity, exaggerated in our own species, makes it possible for such resources to become factored deep into both our physical and cognitive problem solving routines."[75]

In fact, for Clark, it is not simply that tool use was something novel, that the distinctly plastic human brain was able to do, but rather that tool use is all that any organism does. For Clark, ultimately there are no selves; instead, "it is tools all the way down."[76] As I have argued in different ways over several chapters, the study of prosthesis

Extending the Body



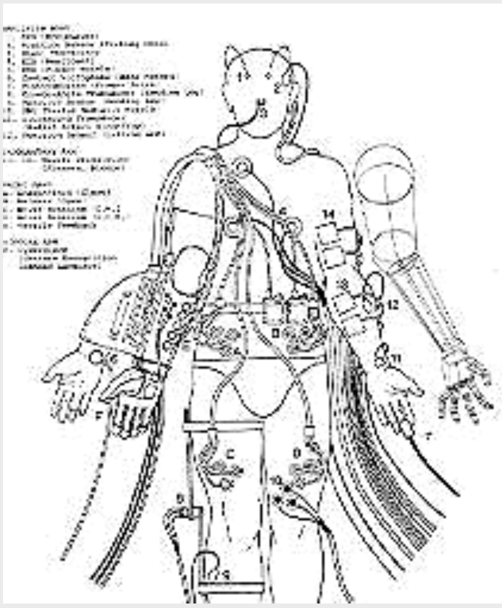


Fig. 6.29-30. The performance artist, Stelarc, has been a leading experimenter of post-human cyborg reconfigurations and extensions of the body, adding both internal and external elements - this project: Amplified Body/Third Hand/ Virtual Arm (1995) Mark Wigley has suggested that in “the reconfiguration of architecture on ecological principles ... Prosthetic extension is a form of ingestion. As the body expands, the environment is literally brought inside. Space gets reconstituted. Architecture is what you swallow.”
Fig.6.31 An early Coop Himmelblau performance.
Fig.6.32 David Greene’s well-known “attempt to mate with a photocopier” in 1980.

and body extension can tell us a great deal about the experience of architectural form and space – for as Marquand Smith has noted, prosthesis is always in complex ways about place.[77]

The fields or maps that surround our body are, then, both experiential and representational. They exist as extended systemic relations between our minds and bodies and the external world. They affect the way that we behave and experience, although at the macrocosmic or classical scale they have no “independent” physical reality.[78] They also have no obvious independent sensory capacity – that is to say, were all of your other senses (such as sight, sound, smell and touch) to be disabled, then it seems that you would not sense in these maps any object entering your peripersonal space.[79] However, these outer maps do affirm a radical ecological mind position in which the organism is absolutely coupled to its environment. There is no single boundary splitting the two, but rather a series of what we might call mentally-mapped metabolisms.

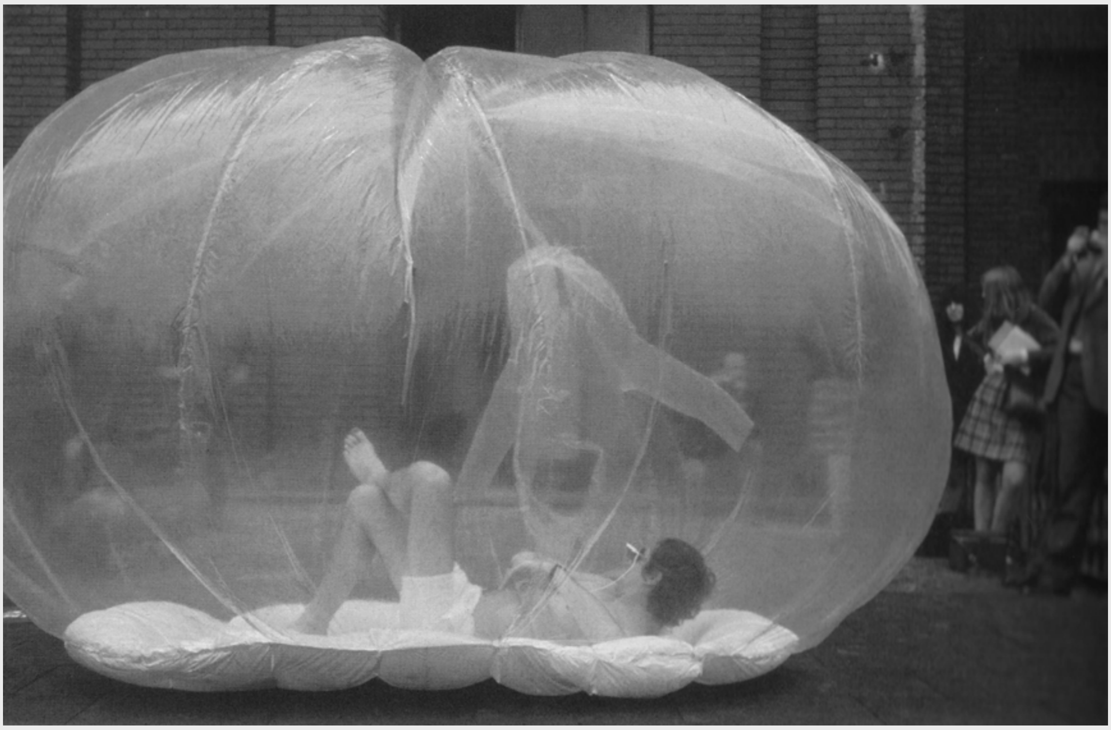
Under particular social and cultural conditions, these maps can be shared between people, in that your maps can extend to include the bodies of others. Whilst for modern western subjects this normally only happens at a non-conscious level, it can enter into phenomenal experience in certain states of consciousness – for example under the effects of certain drugs, or in certain cultural situations, such as sports stadiums or nightclubs or in revolutionary practice, etc.

It also emerges in certain neurological conditions, such as particular forms of synesthesia, such as vision-touch synaesthesia, where (it is presumed via mirror neurons), some individuals can see auras around other people – although this is presumably a projection peripersonal space maps, made visible.[80]

6.11 Architecture as a Dissociative Mapping

The Himba people of Namibia have achieved, it would appear as a cultural condition, a sense of space that is similar to vision-touch synaesthesia. The Himba are particularly conscious of their sense of peripersonal space. They say that they are aware of each others body-field bubbles, and that they feel a direct sense of socially mixing fields whenever they meet anyone. They say that this is a key part of their social existence, and

Nomadic Spatiality and the Experience of Peripersonal Fields



The is a relationship between a nomadic rejection of the normal extended body that architecture provides, and the becoming-visible of the sphere of peripersonal space that surrounds the body – both in the stories of the Himba, and nomadic architectural research by some members of Archigram.
Fig. 6.33. David Greene carries his space around in the 1968 Suitaloon project.
Fig. 6.34. A temporary Nimba Hut.

that they can't imagine how lonely it must be for others who do not experience this as a conscious daily event. According to Blakelee, "the Himba say they are never alone because their space maps fuse with others' throughout the day."[81] It seems also that the shamans among the Iatmul of New Guinea are also able to see a cloud or aura – what they call *ngglambi* – surrounding people.[82]

The Himba people live a nomadic pastoral existence in the Kunene region (formerly Kaokoland), and so there might well be a relationship between their nomadic lifestyle, and the intensified apperception of peripersonal body space. Specifically, I wonder whether there is also a relationship to the lack of actual buildings in their environment for them to project themselves onto, and the fact that they seem to channel some peripersonal space maps through their visual cortex. In this regard, it is striking that in several radical streams of architectural imagination, during the 1960s and 70s, there was an imagining of the individual surrounded by a bubble of space. Typically, this was found in the work where there has been a sustained meditation on a nomadic condition of spatial existence, as a way of theorising a nomadic modern technological condition. We thus can see the emergence of the bubble in the projects of David Greene and Mike Webb of Archigram, in for example the Cushicle and Suitaloon projects. These architects, having rejected the tectonic building as an appropriate medium for the future of architecture, meditated on other technologies that can extend and mediate the social (though typically individual) body and its environment and in their imagination – and, I would argue, once again start to intuit the existence of their own peripersonal space as a potential unit of architecture. For Greene et al, their peripersonal space, once again glimpsed, became reified into a physical bubble.

The reflection upon the particular social and environmental spatial experience of the nomad is vital here. We should remember that we all have peripersonal space maps (and many others) networked in our brains. However, for most of us, our peripersonal maps are not available to our conscious awareness. They are but one of many mental processes that we draw upon within consciousness in all kinds of ways, but which we do not experience as a physical bubble in normal situations.

In fact, one tentative hypothesis, is that it might be the experience of architecture in general, which overrides our peripersonal fields in our conscious awareness? I wonder

Modern Nomads and Bubbles of Space

Fig.6.35. Reyner Banham, The Environment Bubble (1968). One of the rare examples of a collective bubble.
Fig. 6.36 Buckminster Fuller’s proposed bubble over central Manhattan. Struggling towards a collective peripersonal space?
Fig. 6.37 Haus Rucker, at Documenta V 1972.
Of course, the image of the “Spaceship Earth” from Apollo 8 (see Fig. 3.9) might be the largest collective bubble study of this period.

then, if our building activity is quite simply the transformation of this sense of space, into a state of dissociation or alienation? In urban cultures, peripersonal space fields have to undergo constant adjustment and projection through a range of other spaces, and which prefigures in a general sense what Simmel came famously to identify as the blasé condition needed to survive the specific intensity of the modern city. If we live in buildings and cities, our spatial experience is such that our peripersonal space is distorted, extended and overwritten to such an extent that it is not available to conscious experience in any recognisable form (although it is still there in our minds, and we constantly use it in all other kinds of extended ways). However, perhaps for individuals in some human cultures which have not reified their peripersonal space fields into built structures, some of these maps are available to experience consciously as fields, and even to be incorporated into vision. This might suggest that the loops and mirrors within which conscious experience can play is in fact plastic – a point that I will return to again.

There are of course equally big differences between the peripersonal space bubbles of the Himba and the imagination of the 1960s cybernetic architectural avant-garde, and a critique of the later position is all too easy to make. Whereas the Himba are situated within an open “natural” field, Archigram and other architects were imagining an open “post-natural” field – using modern industrial materials and technology – and set within a degrading planetary ecology. Whereas the peripersonal space bubbles of the Himba are mental and social, the Suitaloon project, for instance, is physical and personal. Whereas the Himba people talk about how they experience the mixing of body maps as a primary social experience, the kinds of technological bubbles produced by the 1960s generation of techno-nomadic explorers suggest a quite different social experience. Typically, we find in the latter an expression of a much more isolated and self-defined individual. This time, the individual is in some sense isolated from his or her environment, and is often unable to intermingle and join with the bubbles of others. If anything in these 1960s visionary projects, the primary coupling is not social, but with the stylised commodity of the bubble itself, and perhaps the network of information systems that the bubble is then connected into.[83] It is as if the socio-economic forms of the Himba allow a visceral and visual socio-subjective experience of peripersonal space sharing, whilst

Fig.6.38 NOX, H2Oexpo Pavilion (1999). Lars Spuybroek has explicitly conceived of his projects in terms of prosthesis and cognitive mapping. He states that "with practice and training, the movements of the prosthesis can become second nature, regardless of whether it is flesh, wood or – a little more complex – of metal, as in the case of the car. That is the secret of the animation principle: the bodies inner phantom has an irrepressible tendency to expand, to integrate every sufficiently responsive prosthesis into its motor system, its repertoire of movements, and make it run smoothly ... movement can only be fluent if the skin extends as far as possible over the prosthesis and into the surrounding space, so that every action takes place from within the body, which no longer does things consciously but relies totally on 'feeling '… the body forms itself by action, constantly organising and reorganising itself motorically and cognitively to keep 'in form.'"[111]

under capitalist relations – as we know from Marx (and Archigram) – all social relationships are mediated by and embodied in privately-owned commodities.

6.12 Extrapersonal Space and Affordances

Our peripersonal, or near space, is thus mapped as a direct extension of our body, which in turn is defined by a series of overlapping fields based on vision, and on various body parts. The space beyond that, our extrapersonal or far space, is also mapped, but again separately. This is made clear through examples of the condition of "spatial neglect" which have been documented in individuals with damage to either their near or far spatial mapping. For example, Anna Berti and Francesca Frassinetti have patients with right hemisphere lesions which affects their left peripersonal space. This showed up when asked to indicate the midpoint of a given line. The individual could not do this by hand, in peripersonal space, but they could do it at a distance using laser pen! Revealingly, they could not repeat this same exercise at the same distance using a rod, confirming that the point of the laser was *seen* and thereby in their far space field, but the end of the rod was *felt* as an extension of their body, so was incorporated into their near space! [84]

Rizzolatti (via multiple references to Henri Poincaré and Maurice Merleau-Ponty) notes that because we are mobile beings rather than animals fixed to a location (like say sea-polyps), our extra-personal space always has the potential to become our peripersonal space – i.e. it is always space that we might move into. More than that, he argues that we are constantly surveying both near and far space, using both visual and motor neuronal circuits, looking for opportunities for physical engagement. He quotes Ernst Mach's 1905 paper on "Knowledge and Error", stating that:

> ... 'the points of physiological space' are nothing other than 'the goals of various movements of grabbing, looking and locomotion.' These movements are the starting point from which our body maps the space that surrounds us, and it is due to their goal directedness that space acquires form for us.[85]

This is a very interesting statement in terms of the way that it sets out a series of relations between *form* and *space* as a function of embodied and enacted goals. More broadly

Fig.6.39. Much of the rustication of the Palais Ideal was formed by Facteur Cheval's hand. Such technique necessarily produces a surface articulation which is rich in hand affordances (i.e. groves that one can hold).
Fig.6.40. Rebecca Horn's work has explored the extended active body, in pieces such as "I can touch both walls at the same time."

Fig.6.41. Borromini's *Church of San Carlo alle Quattro Fontane* (1638-41), the kind of interior that *feels* particularly prosthetic and full of affordance at all kinds of scale, and which Wölfflin would describe through an empathetic extension of the mind and body. I am suggesting that when we see decorated and articulated surfaces such as these, we are immediately firing off all kinds of affordance based pre-motor circuits

here, Rizzolatti, like many of the present generation of neuroscientists, makes use of J.J. Gibson's concept of "affordance'" to describe the process that his team have uncovered.

Gibson described himself as an "ecological psychologist", which for him meant that the organism could only be defined and understood in relation to its environment. Gibson's work parallels some cybernetic approaches and prefigures many aspects of extended mind thinking, and provides a key component for the approach that I am promoting in this thesis.

Gibson argued that we see the world in terms of what he called the affordances of objects, by which he meant the actions that they facilitate. Our perception is tied to potential action – whenever we see objects, we also see things that we can do with them – and hence we see affordances that facilitate our interaction and "not only abstract physical [or geometrical] properties."[86] We perceive by observing whether we can sit on, pick up, hold, grasp, throw, etc. these objects, and thereby bring forth our particular species-world. This insight by Gibson into our interaction with the external world is increasingly backed up by neurological evidence, which show that we have maps that do indeed chart such affordances. There are a set of feedback loops between visual and premotor maps that do this. When we look at a cup, our hand is ready to pick it up, and similarly, when we see a step, our legs are ready to step up.[87] The particular network of neurons that are responsible for this have been called mirror neurons, and they are responsible for a whole series of similar projective and mimetic tasks.

As well as responding to objects that the body can engage with in different ways, there are also motor-neuron-based maps which respond to specific three-dimensional forms: "one of the most important properties of the visual dominant and the visual and motor AIP motor neurons is that they respond selectively to specific 3D stimuli. Some respond to spherical objects, others to cubes, others again to flat objects, etc"[88]

It is perhaps worth noting that Bruno Latour has suggested that Gibson's conception of affordance helped him to think about the ways that objects have some kind of immanent agency. Latour states that

> ... there might exist many metaphysical shades between full causality and sheer inexistence. In addition to 'determining' and serving as a 'backdrop', things might

The (impossible) Cognitive Maps of Architectural Form

Fig.6.42-6.43 John Portman's Bonaventure Hotel, Los Angeles (1974-76). Mirrored space has, as I have mentioned on several occasions, been key to grasping something of the mind and body in space. In *Postmodernism*, Frederic Jameson describes the Bonaventure Hotel as a mirrored container that produced a distinctly post-modern phantom body experience. For Jameson, in this interior the very spatiality of late capitalism “has finally succeeded in transcending the capacities of the individual human body to locate itself, to organize its immediate surroundings perceptually, and cognitively to map its position in a mappable external world” (Frederic Jameson, *Postmodernism, or the Cultural Logic of Late Capitalism* Durham: Duke University Press, 1991),p.44). For Jameson, “the alienated city is above all a space in which people are unable to map (in their minds) either their own positions or the urban totality in which they find themselves” (ibid., p.51).

> authorise, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on.[89]

6.13 An Affordance-based Theory of Architectural Pattern and Decoration

If our basic peripersonal space maps inform one kind of architectural and spatial experience, albeit often below consciousness, I think that the *oscillation* between peripersonal and extrapersonal space – as activated and initiated through our constant projection of affordances – is of much more immediate importance to architectural experience. In particular, I suggest that Gibson's theory of affordances might form a key component of an architectural theory of pattern and decoration.

Rizzolatti finds much in the phenomenology of Merleau-Ponty to help him describe the conditions of an affordance based, perception-through-potential-action model of spatial cognition. To be sure, when Merleau-Ponty suggests that "in the action of the hand which is raised is contained a reference to the object ... as that highly specific thing towards which we project ourselves, near which we are, in anticipation, and which we haunt,"[90] we have it seems a fairly accurate description of the processes that Rizzolatti is dealing with. One of the cognitive or empathetic mechanisms through which we respond to architecture is I think precisely in the manner described here by Merleau-Ponty, and clearly, particular kinds of architectural texturing or embellishment will activate this sensibility more or less intensely. I suggest that when we see a moulding, or an articulated surface, we first explore it in our imagination through the haptic affordances that it does or could offer. This can be a conscious activity, but need not be so. It is often semi-submerged in our consciousness, I suspect. We can, if we reflect upon our perceptual activity, sense these projections going on, but often they are transformed into – or joined with – all kinds of other parallel readings that architectural and urban environments initiate (including other cognitive maps and of course symbolic messages).

These processes of engagement with architectural pattern and decoration are similar then to the more mundane affordance calculations that are enacted by our muscles and pre-motor cortex areas, every time that we see, say, a cup on a table. We do not consciously think about picking up every cup that we see, although it can be shown that

Spatial Affordance

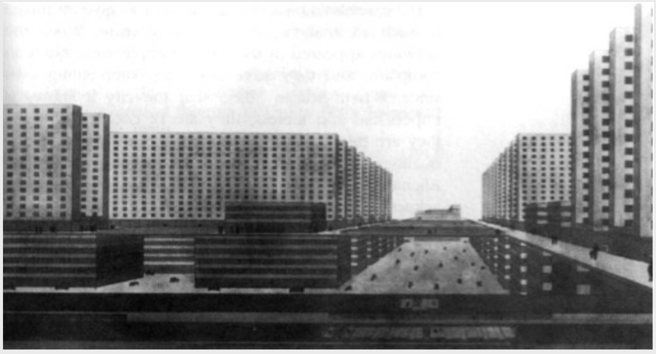


Fig.6.44. Extension to the Museum of Childhood, Bethnal Green, London, by Caruso St John (2002–2007). Although patterned and carefully made, the tension between the resolute flatness of this facade and the geometric suggestion of a patterned depth, make this object strangely frustrating.
Fig.6.45. *Grossstadt Architekture*, by Ludwig Hilbersheimer, 1921. The repetition of the mass building cell, it was proposed, would initiate a new kind of collective empathy.
Fig.6.46 A vernacular Italian rooftop. The tiles, made by shaping clay around the tiler's thigh, is irreducibly full of affordance, and is therefore easy to empathise with.

precisely this is in fact happening in our minds. Anticipating some of the discussion in the next chapter, we can say that a theory of architectural affordance and cognitive mapping suggested here, describes actual modes of spatio-formal empathy.

Affordance also I think work at several scales. It is likely that vernacular, hand-made buildings do by necessity offer more affordances, simply because they are, by definition, entirely composed of components that are hand-held (this is not necessarily to make any kind of value judgement here.) Whilst decorative or constructional patterning often activate these hand-based affordances, there are also I think a whole series of affordances based upon the body as a whole: steps, frames, platforms, and changes in levels. These kinds of spaces take on individual whole body affordances, and also start to multiply them into multi-body affordances too in terms of social space. In this way, affordances define what might be thought of as archetypal architectural elements such as stairs, door openings, windows, etc.

It is important to consider that the perception of affordance is not only a question of practical engagement, or, as I am arguing, aesthetic sensuousness. It might actually play a much more important role in cognition more generally. As Rizzolatti notes:

> ... motor vocabulary ... requires continual interaction between perception and action. However 'pragmatic' it may be, this interaction still plays a decisive role in constructing the sense of objects; without it the majority of the so called 'higher order' cognitive functions could not take place.[91]

Drawing once again upon Lakoff and Johnson's conception of the embodied basis of cognition, and my previous comments upon the potential of our extended bodies to provide the basis of extended concept forms, I suggest that architectural affordances might be key to understanding the role that architectural environments play in extending the metaphors available for adaption to higher cognitive faculties.[92]

It is interesting to consider how affordances might be used in discussing the conditions brought forth by some contemporary structures. The smooth surface of many of the "first generation" of computer-generated "hypersurface" images – and as realised in much recent work by Gehry, Hadid et al – brings forth an ambiguous haptic imaginary. Often a seamless smoothness denies all hand-based affordance, and perhaps thereby

prevents any potential for cognitively "grasping" the object, even whilst their spectral reflectiveness might attract other libidinal sensibility. In a very different way, the facade of the extension to the Bethnal Green Museum of Childhood by Caruso St John offers an image of abstraction, in that it seems to offer a possible visual affordance, yet its flatness denies any need for the motor circuits to engage, and as such it feels strangely frustrating – even whilst this very sense of frustration might be all too accurate an account of the possibility of grasping the contemporary commodity, whether as object or spectacle.

If highly decorated environments can provide places that are full of affordances for humans, is this in fact necessarily stimulating? Might it be just as cognitively radical to be in an environment that is devoid of such possibilities? The large expanses of unarticulated and un-ornamented surfaces that describe the archetypal modernist environment are typically lacking in affordance. Whilst, as aesthetic objects, such environments (classically rendered in for example Hilbersheimer's early sketches) have a painfully therapeutic quality, does one need to have an already highly abstracted sensibility to appreciate this? Would immersion in such an environment result in a restricted extension of cognitive potential, or does it free up the mind for plastic re-conception?[93]

The architecture of Frank Gehry presents a particularly paradoxical case study in haptic affordances. Gehry famously designs his buildings by working with small physical models, like a sculptor. These are then digitised in 3D, and scaled up into buildings. These buildings are thereby shaped into highly plastic-morphic forms, yet the experience of inhabiting these spaces can often remain rather empty. There is I suggest very little scope for affordance-based projection in a Gehry designed structure, as the surfaces are typically smooth and unarticulated. In fact, whilst there can be occasional moments of full body empathy – such as surfaces to sit on or lean against, etc – these too are rare and occur somewhat by chance, as the spaces do not seem to have been designed to be inhabited at all. Gehry's buildings are clearly most effective and engaging when looked at from a distance, or in a photograph. This is because, I would suggest, in those modes of engagement, the viewer is most able to experience an affordance-based relationship with the building as a visual object which has some abstract relationship to its original mode of production – we can imagine holding the small initial model, feeling its contours in our hand. However, whilst making these kinds of objects is a process that is probably good for

Over-scaled Handwork

Figure 6.47 and 6.49. Frank Gehry, Bilbao Guggenheim.
Figure 6.48. Frank Gehry's design method is lampooned in *The Simpsons*

As hand-made models, Gehry's architecture makes some kind of "sense": a bit like the sensation models that are used by visually impaired children. When scaled up into buildings, however, it is less clear what responses might be expected from the viewer or user.

the brains of the architects and clients involved, as they explore affordance with the original hand-held models, it is in fact ultimately creating a new and extreme form of spatio-mental elitism?

6.14 Mirror Neurons and Empathy

In recent research it has been suggested that what have become known as mirror neurons are actually the neurological correlate of the empathy-type spatial sensibility of the mind discussed above. It is these neurons that bring together much of the cross-over between haptic, motor and visual systems, and it is these neurons that initiate the mimetic projections that mean that when we confront the world, we confront an array of affordances.[94]

According to popular anecdote, mirror neurons were discovered by chance in the laboratory of Giacomo Rizzolatti, when they realised that certain motor circuits were activating in monkeys when they were watching the scientists pick things up. According to Rizzolatti:

> ... [the] recognition of the actions of others, and even of their intentions, depends first of all on our motor repertoire ... the mirror neuron system is indispensable to that sharing of experience that is at the heart of our capacity to act as both individual and as members of a society. Forms of imitation, both simple and complex, of learning, of verbal and gestural communication, presuppose the activation of specific mirror circuits ... emotions, like actions, are immediately shared. The perception of [the emotions of others] activates the same areas of the cortex that are involved when we experience these emotions ourselves.[95]

The theatre director, Peter Brook, has commented that mirror neurons have done no more than explain what was “common knowledge” in the theatre world: that performances are always collaborations between audience and actor. Again, for Rizzolatti:

> ... the study of mirror neurons appears to offer, for the first time, a unitary experimental and theoretical framework within which to decipher this form of shared participation and ... the basis of our common experience.[96]

The same comments that Brook has made regarding theatre can I think be applied to architecture. In the case of architecture, mirror neuron systems play roles in many of the processes that will be discussed in the next chapter regarding the aesthetics of empathy. In both of these aesthetic models (i.e. architecture and theatre) there is some kind of feedback loop set up in which mind emerges as a system of projections out from the human subject, as well as sensory inputs in from the external world.

In an important sense, these aesthetic epistemologies are more in line with contemporary cognitive models than many of models that characterised twentieth-century biological schema, which tended to imagine a linear connection between perception producing cognition producing movement.

6.15 Grid Cells, Place Cells and Entoptic Pattern Projection

The final modes of cognitive mapping of space to be considered are in some ways not grounded directly in body-based action at all. They are in fact surprisingly abstract and geometrical mappings, and form the basis of our large scale comprehension of space. Grid cells and place cells are located in one of the “oldest” parts of the brain – the hippocampus – and provide a very different type of spatial cognitive mapping to those so far discussed.[97] However, just like our peripersonal space mappings, I suggest that we can find projected abstractions of these neuronal structures within our built environments, just as we can interpret our neuronal structures as interiorised mirrors of our environments.

Most of the body maps discussed so far have been egocentric: they are based in the human body, and are key to any sense of self. Place and grid cells, however, are more geocentric, and as such are two-dimensional. Place cells are organised according to the actual place and space that the body is in.[98] They are formed as a particular permutation of cells each time you visit a new space-place, and seem to be an important component in the mechanism by which we recognise places. Equally, although place cells seem to exhibit strong metric properties, the cognitive map of the place cells can be informed by the dynamic body based cognitive maps discussed above.[99]

Grid cells are located in the entorhinal cortex in the hippocampus, at an organisational level above place cells.They fire as the body moves in space, although the grid that they describe is an hexagonal co-ordinate system (not our more familiar orthogonal grid).[100] In addition, “head direction cells” work with place and grid cells, and fire whenever the head is facing a particular direction. They seem to form the basis of an innate sense of cardinal direction, whilst “spatial view cells” are attached to significant objects or views in an environment.[101] Like almost all brain regions, the hippocampus has a significant ability to plastically re-organise itself on the basis of lived experience and practice, and a recent study by Eleanor Maguire has shown that London cab drivers have enlarged posterior hippocampi, with experienced drivers show greater enlargement than new drivers.[102] It would be interesting to see what the hippocampi of architects are like, although I can find no studies of this as yet!

The hippocampus, as well as dealing with these spatial tasks, plays an important and related role in memory formation. There is in fact some debate concerning what emphasis should be placed on the specifically spatial role of the hippocampus, as opposed to viewing abstract spatial cognition as just one case of a broader provision of *relational* memory.[103] It has been demonstrated that the hippocampus is involved in cognitively mapping non-spatial relationships, such as family and social relationships, and indeed in positioning ideas within relational frameworks. Indeed, the mnemonic power of the hippocampus in managing spatial relationships has been consciously used at least since the time of the Roman Republic, when orators were taught to remember their speeches by imagining that they were walking through a building, with each room representing a particular point. Recent research seems to be concluding that the hippocampus is primarily concerned with space, and it is through our lived spatial relationships that we have developed a broader capacity to organise memories, and think relationally.[104]

6.16 Embodiments of Mind

> Knowing is an action of the knower ... all knowing depends upon the structure of the knower ... it is rooted in the very manner of his lived being, in his organisation. We hold that

> the biological roots of knowing cannot be understood only through examining the nervous system; we believe it is necessary to understand how these processes are rooted in the living being as a whole.[105]
> [Humberto Maturana and Fransisco J. Varela]

Clearly, the relative spatial abstraction of grid cells and place cells creates a very different basis for cognitive mapping than the empathetic-prosthetic relationships with external world that the network of body-based cognitive mappings discussed earlier in the chapter facilitate. Still, in all cases the human organism and its environment are co-constituted through a mapping process, and in terms of our experience, a “world is brought forth” through spatial practices of various kinds. Importantly then, it is not simply that the body and its various spaces are mapped in the human mind, but rather, the human mind and human consciousness, are in large part *produced through* these spatial practices and the associated network of mapping processes. Understanding the experience of this dialectical relation between organism and environment is what Varela and Thompson have described as neurophenomenology. Clearly, by definition such a conception contains no implication of a “natural” or stable human condition

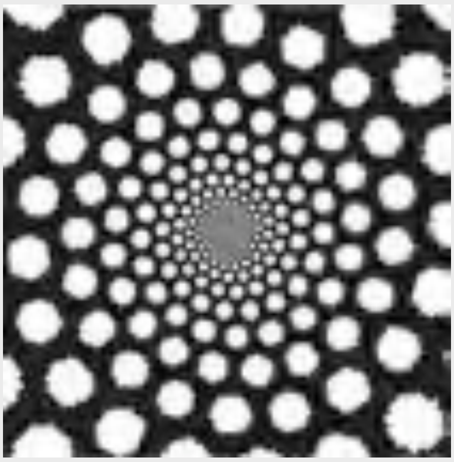
I have also introduced another conception of cognitive mapping, a critical-theory-based extrapolation of an urbanistic concept developed by Kevin Lynch, which was later used by Frederic Jameson to rethink concepts of totality found in Lukacs and Hegel. These two conceptions of cognitive mapping share more than a relation to urbanism (interesting though that is). They also seem to reflect in some way something that seems to happen in the hippocampus – a spatialising moment that structures our ability to organise both abstract mental concepts and our own biophysical bodies.

Spatial practice and the consciousness it produces would seem to be a likely precondition for advanced relational memory and abstract conceptualisation. The organising of stones in space by humans, and the experience of recognising patterns of organised matter in the external world, is a precondition for, or perhaps co-emergent with, the conscious organising of abstract thoughts. The sociological thinker Georg Simmel, and the architect-turned-social-commentator Siegfried Kracauer – both of whom I will discuss in the next chapter – noted that something interesting happens when the “external” space that is mapped “internally” in the mind, consists of a space that is already

Let’s get these stones organised!

Might it be that the organisation of stones in Carnac are in fact a drug-induced projection of grid cells? Does the placing of stones in a line co-evolve with the ordering of ideas or even words in a sequence?

Fig.6.50 Field of standing stones at Carnac, France.



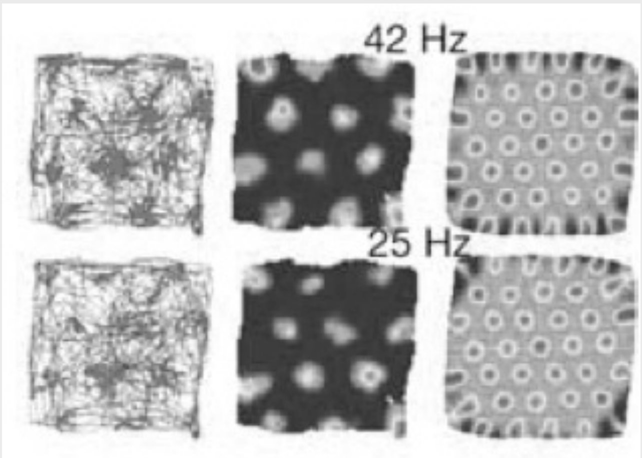


Fig.6.51 The kind of entoptic pattern most frequently reported in psychadelic experience, interpreted as neuronal structures with recursive feedback through the visual cortex.
Fig.6.52 EEG mapping of grid cells in rats.

an externalisation or alienation of the human mind – that is to say, when the space or object mapped is not simply "found" by the subject, but has already been socially produced.

In the megalithic grid structures of Carnac in Brittany, it could well be that we are seeing the first steps towards social forms of human conscious abstraction via a projection of internal grid cells in the human brain. The organisation of the stones is a necessarily social act, as indeed is their experience. Once externalised and manifested as objects, these become visions of a rational space. They act as mirrors of the mind's structures and can be mimetically reintegrated into consciousness. Grid cells, with their apparent prefiguring of something like a Cartesian grid, seem to provide an unexpected neurological basis for what Lefebvre would later refer to as abstract space. When we look now at the grids of modern city planning are we really just looking at a socialised extension of our hippocampus?

Whilst highly speculative, David Lewis-Williams has suggested that similar processes might be responsible for the emergence of modern human intelligence. Lewis-Williams argues that the patterns that can be found in Palaeolithic petroglyphs (and indeed in the production of extant shamanic and nomadic cultures, and especially in San rock art), show strong signs of being related to the induced experience of entoptic patterns – that is to say, patterns which are based in the structures of neurological organisation.[106] For Lewis-Williams, as for the even more speculative Terrence McKenna, ingested psychoactive botanics are suggested as a possible stimulus for this process.

Entoptic phenomena are geometric patterns that emerge under particular conditions, and consist of two types.[107] These are phosphenes and form constants. Whilst phosphenes are induced by physical pressure on the eye, or entophthalmic structure within the eye, form constants derive from the structures of the bigger optic system. Lewis-Williams summarises the condition as follows:

> ... there is a spatial relationship between the retina and the visual cortex: points that are close together on the retina lead to the firing of comparably placed neurons in the cortex. When this process is reversed, as following the ingestion of psychotropic substances, the pattern in the cortex is perceived as a visual percept. In other words, people in this condition are seeing the structure of their own brains.[108]

Externalising the Mind

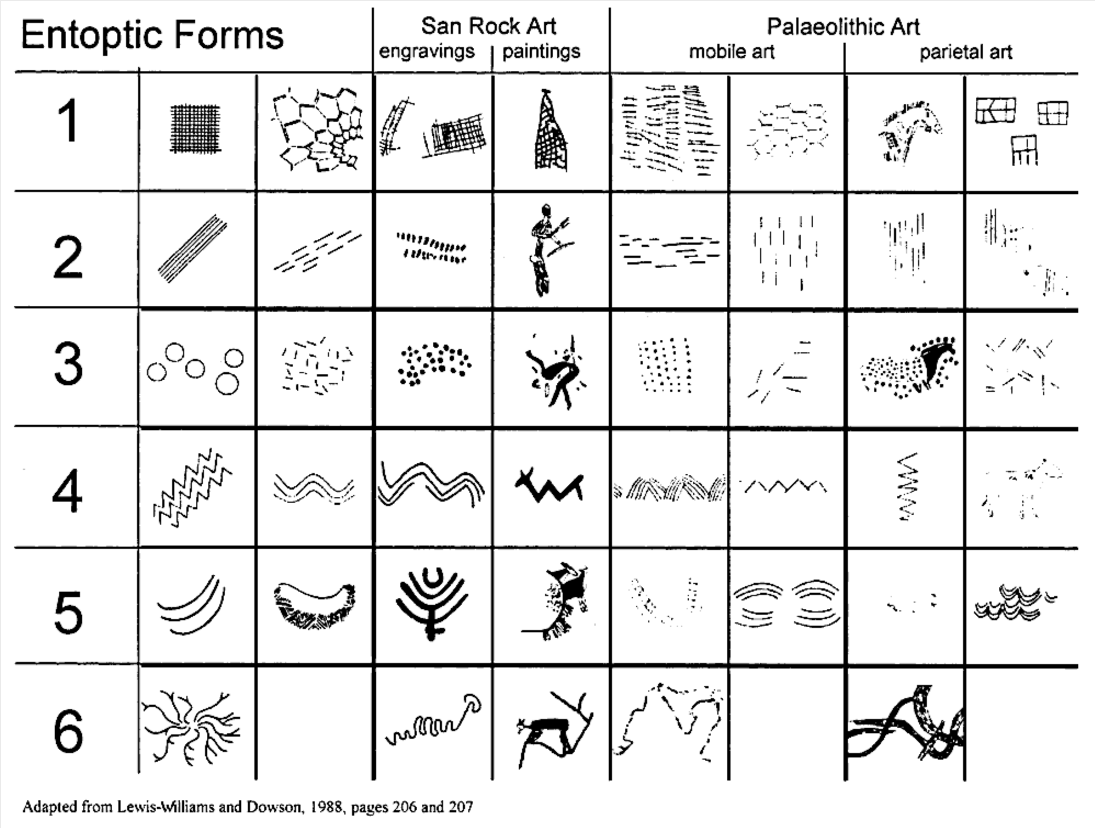


Fig.6.53 A matrix diagram comparing entoptic patterns, San rock art and Paleolithic art.

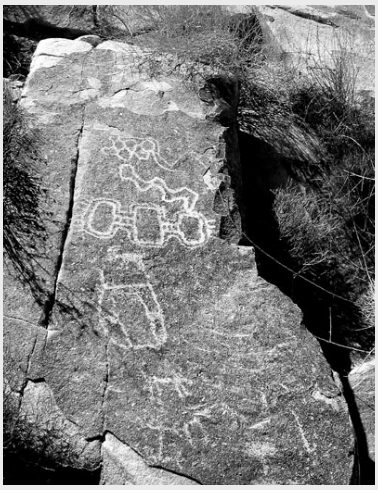


Fig.6.54 Petroglyphs showing entoptic patterns in Grapevine Canyon, Nevada.

Fig.6.55 The oldest known example of abstract human thinking is a pair of iron ore stone ochre, decorated with abstract criss cross designs, and dated to 70-75,000BC. These were found in the Blombos Cave in South Africa.

These initial projections of internal mental objects out into the external world, create a distinctly mirrored condition. Whilst, as noted in the previous chapter, we are in a sense only able to engage with or empathise with anything in the world in so far as it too has aspects of mind – i.e. it is in some way patterned. For Gregory Bateson of course, recursive mental patterning characterised all living material systems, and was the basis of our initial apperception of, and ecological mental extension into, our environments. However, the more that we have structurally-coupled ourselves to our environments, and the more that we have re-shaped and re-patterned our world, then the more it is the case that the objects that we empathise with are in fact externalisations of our own minds, and have been made with our own bodies (and thus are thereby especially full of affordances) a particularly intense feedback mechanism occurs. This mirrored feedback between the body-mind and a projected environment creates the recursive pre-conditions for the emergence of modern self-consciousness and complex language, with all of the benefits and delusions that these brings. It is hard, then, not to see the urge to create architecture coming out of these processes.

In the next chapter I will turn to consider ideas associated with nineteenth-century empathy theorists in Germany, in terms of the realisation that there was something happening in space, some kind of extended feedback relationship between our minds, our bodies, the environments with which we co-evolve, and the objects that we make, use and find. Empathy theory can even be said to have constituted an early form of extended mind theory. Whilst there have been both idealist and materialist constructions of empathy theory at different stages of the historical development of the concept, there has not yet been an explicitly modern, political and ecological formulation. It is intended therefore that that these two chapters might provoke further research work in that direction.

7 Aesthetics, Technology, and the Spirit of Matter[1]

> So by 'aesthetics' I mean responsiveness to the pattern which connects. The pattern which connects is a meta-pattern. It is a pattern of patterns. It is that meta-pattern which defines the vast generalisation that indeed it is patterns which connect.[2]
> [Gregory Bateson]

7.1 Empathy, Mind and Aesthetics

In the previous chapters, it was noted that the concept of *empathy* has been turned to on several occasions by thinkers within the cognitive sciences. For George Lakoff and Mark Johnson, as for Evan Thompson, some concept of empathy is necessary to grasping both the nature of inter-subjectivity, and – as part of the same process – recognising the specific process by which our environment itself is productive of and constituting some kind of subjectivity. Empathy thereby contributes to an active extended component of our subjectivity as humans. For Gregory Bateson, empathy suggested a route by which patterns (which for him are mental processes, or the traces thereof) might be recognised in very different kinds of organised differential material systems. Once recognised, patterns might then be seen to be related to each other by other patterns, seen through a process of abduction which itself shares something with empathy so as to reveal endless higher, lower and transversal levels of patterned abstraction. For Bateson, the process of projecting ourselves into the world "with recognition and empathy" is essential if we are to gain what might be described as a living feeling for the specific forms of rationality produced by the ecologies within which we produce ourselves.

So what, then, is meant by empathy? I will need to approach this question from several directions over the coming pages, but we can start with a standard dictionary definition, that the everyday meaning of empathy describes "the ability to sense and understand someone else's feelings as if they were one's own," while also noting that it is an anglicised form of the Greek *empatheia,* meaning affection or passion.[3] In fact, the word *empathy* is a fairly recent addition to the English language, being coined by Edward Titchener in 1909 as the translation of the German word *Einfühlung*[4] (literally 'feeling into'), which he found used extensively in the work of the aesthetic-philosopher-turned-psychologist Theodore Lipps (whose work he was translating).[5] There is in fact an

important history of concepts that lie behind this seemingly innocent word, which connect it directly – and no doubt surprisingly – with the formulation of the concept of “space” in modern architectural aesthetics and phenomenology.

Empathy as a concept has indeed an irreducible basis in spatial aesthetics, and its use as a fundamental component of some contemporary cognitive philosophies brings architecture into the heart of discussions about human consciousness. What is so fascinating about this etymological history is that it also appears to be an accurate reflection of neurological relations. Recent research into what have become known as mirror neurons (discussed in the last chapter) suggests that they play key roles in what are now seen as three interrelated processes. Firstly, mirror neurons are involved in the cognitive mapping of the space of the body, and the body’s technological extensions through the use of tools. Secondly, mirror neurons are central to constructing our theories of mind regarding other people (i.e. recognising other minds). Thirdly, mirror neurons play key roles in language. This suggests that the historical development of the concept of empathy, from spatial aesthetics to psychology and the cognitive sciences, is not merely a linguistic accident, but actually reflects a socio-biological relation: i.e. an extended network or system in which space and language are socially produced. Architectural knowledge concerning spatial aesthetics might have a real contribution to make here, then, in understanding and working out an extended theory of mind in broader terms.

Titchner’s choice of empathy as a translation for *Einfühlung* makes clear the word’s relationship to *sympathy*, and in particular the old alchemical or medicinal sense of this word, as a sympathetic attraction between things as well as people.[6] It was in fact this sense, as a way to understand the “alchemy” of art – or, how it is that “form” might be related to, and found attractive or beautiful by viewers – that *Einfühlung* had initially been used by the German art theorist, Robert Vischer, in 1871, in its first modern aesthetic use. However, the underlying concept of *Einfühlung* – that we are in constant physical and mental feedback or dialogue with the entire world around us – was deeply rooted in both esoteric philosophy and mainstream German thinking, and had been for instance clearly expressed in the aesthetics of German Romanticism.

The first published use of the term *Einfühlung* was by Johann Gottfried von Herder, in *This Too: a Philosophy of History for the Formation of Humanity* of 1774. In his essay,

Herder proposed the concept of empathy as a historical-critical method: that is, a way of feeling oneself into the mindset or spirit of other times and places, in order to understand the meaning of their works of art. Importantly, as Joseph Rykwert points out, for Herder processes of *Einfühlung* were essential to his elaboration of the notion of organic principles in political life and community.[7] Herder also frequently suggested empathy-like, psycho-physiological readings of formal expression, such as in his sentence stating that "the beauty of a line is movement, and the beauty of movement, expression."[8]

Herder's colleague, Johann Wolfgang von Goethe, also developed a method of "feeling-into" as the basis of his organicist and proto-phenomenological "living science". Goethe's experiential scientific method, as elaborated in texts such as *The Experiment as Mediator between Subject and Object* (1772) and *The Theory of Colours*(1810), was based upon the proposition that the "holistic scientist" should feel themselves into the object of study, until a sudden organic and "intuitive" understanding of the whole living process at hand occurred.[9]

Like Titchner, Sigmund Freud was indebted to Lipps' subsequent development of the concept of empathy, seeing it as "essential for establishing the rapport between patient and analyst that makes interpretation possible".[10] The term *Einfühlung* first appeared in his paper on "Jokes and their Relation to the Unconscious" (1905). In this paper, Freud noted the close relation between empathy and "mimesis", a move that was to have significant influence.[11] Both Walter Benjamin and Theodor Adorno referred to this paper of Freud's when developing their own ideas around mimesis as an art-philosophical concept, and there is an under-acknowledged, although direct, connection between the aesthetico-critical concepts of empathy and mimesis. It is, for example, wholly in a sense derived from empathy that Adorno said that "by means of the mimetic impulse, the living being equates himself with objects in his surroundings."[12] Benjamin's use of mimesis to unpick the commodity could similarly be considered to be an unknowing return to the young Marx (whose 1844 *Paris Manuscripts* were not published until 1927) and the emergence of empathy within associated young Hegelian circles, as we shall see. It is also worth noting that recent work by Neil Leach, for example, has – by drawing on Benjamin and Adorno – used mimesis and empathy together.[13]

Lipps' development of empathy, firstly in an aesthetic sense, and then later to "explain how we discover that other people have selves",[14] has been very important in the development of modern psychological discourses: it can be said to have constituted psychology's first theory of mind. Today, our recognition of other minds is broadly known in psychology as having 'a theory of mind' (also known, confusingly, as "theory theory"), and is often referred to as cognitive empathy. In embodied mind thinking, as discussed in Chapter Five, empathy constitutes a key third moment in describing the essentially inter-subjective nature of self. As Thompson describes it, "self and other enact each other reciprocally through empathy."[15]

7.2 Empathy and Spatial Prosthesis

What, therefore, can be said to be the basis of this aesthetic concept of empathy? Empathy is the idea that we experience physical form through processes of relational projection, imagining ourselves onto the shapes, or into the spaces, of the world. Empathy suggests that architectural experience, or at least the physical, kinaesthetic, phenomenological and non-iconographic components of architectural experience, might be thought of as a fundamentally prosthetic impulse. Consider for instance the experience of driving a car or riding a bike, or even just using a tool. Our cognitive map of the limits of our body quickly expands to include the vehicle or tool as a prosthesis, almost as soon as we start to work with it. We are, for example, acutely aware of the limits of the vehicle, and feel any potential collision as an impingement upon our own self. We feel it by extension as a part of our body. Empathy theory asserts that we experience form and space in precisely this way. We imagine the building and our spatial environment as a second skin, an extension or projection of our body and our psychology: we wear spaces and morphology like clothing or a membrane, an interface or prosthesis, physically and psychically, and indeed socially and collectively. Hermann Lotze, in one of the earliest formulations of this concept, suggested that "no form is so unyielding that our imagination cannot project its life into it."[16] The cognitive map or body-image that we carry around with us is constantly adapting to the environment that we find ourself in, and for all of these empathy theorists, the moving, active body was key to understanding these dynamic

processes of adaptation. When in a building or a city, one expands into and empathises with it. Empathy theory describes space (and the objects contained by space) as an alienated, yet recoverable organ of our individual and social bodies. It is the medium through which mind and matter connect through pattern and form, a “utopian” joining of subject and object. Empathy, in Bateson’s language, is the meta-pattern that connects patterns in the subject with patterns in the object.

Empathy developed thus as one of a three closely interrelated terms: empathy, form and space. And as soon as we start to investigate the interrelated developments of these concepts, we find that we are engaged in a distinctly second-order systems discussion of pattern/matter relations in cybernetic terms. By second-order, I mean that there are patterns immanent in the organisation of the object matter (in this case, architectural objects) and there are also patterns immanent within the subject matter, which is the perason using the building. Empathy, I suggest, must be understood as the study of the meta-pattern that connects these co-evolving patterns.

The concepts of empathy, form and space underwent an extraordinary development in the final decades of the nineteenth century and the first decades of the twentieth. These ideas continued to develop throughout the twentieth century, although were increasingly articulated in architecture through a more abstract discourse on “space” and “form” rather than “empathy” as such. The history of the development of these concepts has finally started to be written in recent decades, and I am indebted here to a series of texts. The first important and most encyclopaedic review was produced by Cornelis van der Ven in 1978,[17] although it is not clear how much influence this book had at the time of writing. However, just over a decade later, in 1991, a paper by Mitchell Schwarzer in *Assemblage*[18] seems to have been much more successful in bringing into contemporary critical theory and architectural history a recognition of the role that the aesthetic discourse on empathy had in the formation of the modernist concept of space in architecture. The success and influence of the Schwarzer paper was no doubt in part due to the fact that a couple of years later, in 1994, Harry Francis Mallgrave and Elephterios Ikonomou published an important edited collection of translations into English of the major texts of nineteenth-century German aesthetics, including the key papers by Robert Vischer, Heinrich Wölfflin, Adolf Hilderbrand and August Schmarsow on empathy, form

and space. The publication of Mallgrave and Ikonomou's collection opened up a new phase of research amongst Anglophone architectural historians, notably including Adrian Forty's substantial entries on "Form" and "Space" in his book on *Words and Buildings* (2000).[19]

"Space" and "form" have had a fairly continuous ongoing development during the last few decades. Most notably perhaps, thinking around space has been dramatically extended through the translation in the early-1990s of ideas from the French Marxist philosopher Henri Lefebvre, which has not only impacted upon the associated disciples of urbanism and geography, but has also been brought into architecture directly through (albeit in very different ways) the writings of architectural theorists like Bernard Tschumi and Iain Borden. "Form", too, I would say, has continued to undergo development, in for example certain attempts to theorise and talk about emergence and parametrics.[20] At the same time, empathy also underwent a period of renewed conceptual development in design theory and practice, as a way of thinking about movement in animation and parametric design, by for example Lars Spuybroek and Kari Jormakka.[21]

7.3 Space and Mimesis

When reading architects talk about space, it often seems like they are referring to a mystical, metaphysical substance. This for instance is Le Corbusier on the subject:

> ... the architect, by his arrangement of forms, realises an order which is a pure creation of his spirit; by forms and shapes he affects our senses to an acute degree, and provokes plastic emotions; by the relationships which he creates he wakes in us profound echoes, he gives us a measure of an order which we feel.[22]

In recent decades, post-modern critics have often attacked this kind of discourse around space in modernist architecture, suggesting that it is an obscurantist attempt by architects to be elitist, to confuse clients and to confuse each other, and reflects a social desire amongst architects to be able to talk about something higher than the banalities of everyday construction. Whilst there is no doubt some truth in all of these assertions, I would argue that what appears to be a rather mystical and esoteric discourse, describing

obscure projections between mind and matter, is in fact simply and precisely that, and needs to be taken seriously as such (rather than merely dismissed as elitist *per se*). The architectural-aesthetic concept space does indeed have some very rhizomatic roots through a series of panpsychic and theological concepts.[23]

Even whilst various concepts of space have had a long history in the natural sciences, philosophy and mathematics, as Adrian Forty notes, “outside a small circle of German aesthetic philosophers ... ‘space’ simply didn’t exist in the architectural vocabulary until the 1890s.”[24] The concept of space was introduced into architectural discourse by August Schmarsow and Adolf Hilderbrand, and was intended as a supplement to the already established concept of form and as a tool of art historical analysis.[25] Further developed by fellow historians Alois Reigl and Paul Frankl, Schmarsow’s proposition that “the history of architecture is the history of the sense of space”[26] was to be used to understand the formed spaces of different times and places as the traces or manifestations of different social, mental and cosmological sensibilities. As architectural historians they tried to empathise with the spatiality of other times. However, the term “space” quickly started to operate as a synthetic and propositional concept as well. Space was felt by modern architects as a complex concept which was able to express and manifest the emerging sensibilities and aspirations of modernity, in particular the concept of abstraction. The conception of architectural space developed by the empathy theorists was disseminated widely through the writings of Wilhelm Worringer, Siegfried Giedion, and by Walter Gropius who, van der Ven suggests, “adopted the idea of space as the core of the artistic research of the Bauhaus”[27] – the *leitmotiv* of an abstract yet *sachlich gesamtkunstwerk* led by architecture as the “mother art”.

For these modernist architectural thinkers, it was through working with space that architecture might be able to contribute to and articulate a new international language, grounded in what humanity shared – our bodies and their spatial practices – rather than struggling with what Adolf Loos had famously dismissed as the impossibility of forming a modern metropolitan collective language based upon old or local symbolic ornamentation.[28]

In the account of empathy and space that follows, I wish to focus on three areas of analysis that are missing from the existing literature. The first primarily concerns the

historical interpretation of the emergence of the aesthetic discourse around empathy. Specifically, I argue that important strands of this discourse emerged from Young Hegelian circles, and, in addition, had a “panpsychic” component.[29] This historical account is in fact quite novel: the existing literature has almost exclusively emphasised the importance of Kantian aesthetics to these later German thinkers.[30] The Kantian interpretation is important to be sure, but it is also incomplete.[31] Importantly, I think, a consideration of the Young Hegelian tendencies within empathic aesthetics allows relations to emerge with other thinkers from this tradition, notably Karl Marx. In fact, just as Schmarsow suggested that the sense of space underwent historical development (an obviously Hegelian and not Kantian idea), Schmarsow’s near-contemporary Karl Marx developed a number of ideas precisely about the historical production and social development of the human body and senses (not long after he had read Hegel’s *Aesthetics*). It is useful therefore, I think, to read these two thinkers together. Furthermore, as already noted, some aspects of a later Marxian aesthetics in and around the Frankfurt School – notably the concept of mimesis of Benjamin and Adorno – develops directly out of the psychological aesthetics of empathy.

A consideration of these questions opens up questions concerning the relationship of an empathic phenomenology to technology, and the applicability of this approach to thinking about the new forms of spatiality which emerged throughout the twentieth century – in particular network architecture – and to considering how ideas concerning empathy are now playing an increasingly active role in interaction design today.

Finally, I will conclude the chapter as I started, tracing the relation between the origins of empathy in spatial aesthetics and the contemporary deployment of a conception of empathy in the theories of embodied mind philosophers and cognitive scientists. This connection has until recently been entirely missing from architectural accounts, and whilst work involving empathy in psychology or the cognitive sciences often provide accounts in passing of the origins and resonance of the term, these are often incomplete or simply incorrect. Getting this matter right is important, as I am asserting that empathy has a specifically spatial contribution to make to extended and embodied mind approaches to theorising mind and consciousness. Just as importantly perhaps, in terms of Bateson’s

account, is that it is the distorted form, or even lack, of a modern empathy with ecological systems, that instantiates what Marx described as our “metabolic rift” with nature.

7.4 Pantheism and the Young Hegelians

> Germany is now the fertile soil of pantheism. This is the religion of our greatest thinkers, of our best artists ... Pantheism is the open secret of Germany.[32]
> [Heinrich Heine]

As mentioned above, the standard interpretation of the emergence of the German aesthetics of empathy typically describes it in terms of Kantian aesthetics. Adrian Forty, for example, repeats this interpretation of the origins of empathy, stating that Kant was “effectively the founder of this philosophical tradition.”[33] For Kant, of course, space was an *a priori* category, something which was structured into the mind, and which in turn structured bodily and mental experience of the world. Mallgrave and Ikonomou describe Kantian categories as:

> ... the presumption that we actively constitute form and space in our schematization of the world. They are, in effect, mental constructions of the observer, the subjective condition under which sense perception operates. They are less an image corresponding to an external reality and more a mode under which we arrange the objects of perception, a transcendental ideality.[34]

Whilst this clearly captures something of the active role of the observer in producing empathic spatial and formal experience, this remains on the whole, I think, fairly unconvincing as the primary source of empathy. Empathy was, right from the start, a much more systemic and mutually dynamic conception of relations between mind and matter. As we shall see, empathy is not at all accounted for simply as a theory of observation. Empathy is always a system, and always a reflexive or dialectical relationship between a mutually constituting subject and object. In empathising, there are projections connecting the imagination of the observer and the object, but these projections in a complex way subjectify the object, and are projected back, completing the loop. In the earliest roots of empathic thinking, these projections are imagined to be real spiritual

processes, and are as such immersed in a very non-Kantian set of discourses that were very much alive in eighteenth- and nineteenth-century European and specifically German culture – which, as Heinrich Heine suggests in the quote above, had more to do with pantheism (everything is god) and panpsychism (all matter has mental properties) than with Kantian critical philosophy.

Specifically, then, I suggest that we need to understand the development of the concept of empathy in relation to, on the one hand, the philosophy of Hegel, which was perhaps the first major modern dynamic systems theory, and, on the other, broader tendencies in German culture, in which organicist, panpsychic, animist, gnostic, romantic and neo-platonic philosophies were never far from the surface of intellectual debate – whether articulated through vernacular organicist conceptions of nature, or the substantial philosophical tradition of panpsychism, most notably including Leibniz, Herder, Goethe, Schopenhauer, Lotze and Spinoza (who whilst not German exerted a major influence there).

In fact, Hegel's system can be seen itself as a particular form of idealist panpychism, describing a universe pregnant with mind striving towards self-consciousness, a subject/object continuum in which these two poles are not entirely separate and discrete – i.e. this is me here, and that object over there is not me – but rather are connected areas of intensity within unfolding and evolving systems of mind and matter (objectified mind), or fields of alienation and relational abstraction. It is within this context of both vernacular and philosophical traditions of panpsychist thinking, and more specifically of course the legacy of Hegelian thought, that the Young Hegelians emerged around the University of Berlin, in the early-to-mid nineteenth century. Of this group, Ludwig Feuerbach, Karl Marx, Friedrich Engels and Frederich Theodore Vischer are of particular interest here.[35] All of these writers were to develop theories of projective alienation. Feuerbach first directly attempted a materialist reworking of Hegel, and specifically attempted to reverse Hegel's emphasis on the role played by religion in understanding mind and matter. In *The Essence of Christianity* (1841), he argued that rather than some universal spirit being present in and realised though man, it was rather man that created God and religion, as projections – and thus as alienated forms – of himself. The importance of Feuerbach's influence upon Marx is well documented, not least by Marx himself. Less well documented

– in fact almost completely un-commented upon within Marxian scholarship – is the influence of Frederich Theodore Vischer, whose major work, the four volumes on *Aesthetics* (1846-56), we know was read and returned to by Marx at various times in his life.[36] Vischer's *Aesthetics* was a massive study based upon Hegel's own book on *Aesthetics.* For Vischer, the subject of aesthetics is important as he finds in it a more advanced stage of spiritual development than religion, and it provided for him something similar to what Marx had in parallel described as "making the world philosophical."[37] In the words of William J Brazill, the role of aesthetics for Vischer is seen as:

> ... the overcoming of alienation, a progressive fusion of human consciousness with matter that was itself the meaning of history. Thus for Vischer aesthetics was the key to human development, for man fashions his own consciousness in historical forms so that he might know as an object the spirit inherent in himself.[38]

Whilst, no doubt, Marx would have been influenced by Hegel's text on *Aesthetics*, rather than by that of Vischer *per se*, it is clear nonetheless that he maintained an interest in Vischer's book. It is this that constitutes, I suggest, a link between two revolutionary new discourses of the nineteenth century: on the one hand that of Marx, and on the other that of the architectural and aesthetic concepts of space and empathy. In both of these discourses, as arguably in Hegel himself, subject and object co-evolve in dynamic systems and relational networks that display immanent or what we would today describe as emergent or animated properties.

Hegel stated that "art spiritualizes, it animates the mere outward and material object with a form that expresses soul, feeling, spirit."[39] However, if for Hegel the aesthetic object is really an expression or objectification of mind, and for F.T. Vischer it was rather more like humanised matter, for the latter's son, Robert Vischer – who as I noted used the term *Einfühlung* – it was more clearly, as van de Ven describes it, "that the soul was no longer innate in the object observed, as Hegel maintained, but it was rather a projection from the individual observer."[40] In other words, Hegel's spirit was now becoming space itself.

In his essay *On the Optical Sense of Form* (1873), Robert Vischer builds upon an panpsychic phenomenology and aesthetics taken from the elder Vischer's work,[41] but developed through a cross-reading with the insights of the proto-Freudian Karl Albert

Scherner, whose work on *The Life of the Dream* (1861) was acknowledged by the younger Vischer when he wrote:

> ... here it was shown how the body, in responding to certain stimuli in dreams, *objectifies itself in spatial forms*. Thus it unconsciously projects its own bodily form – and with this also the soul – into the form of an object. *From this I derived the notion of empathy*.[42]

In this ambitious text, Robert Vischer outlined the major components of a sophisticated theory of architectural empathy, developing a socio-biological thesis on beauty through a series of descriptions of different types of formal empathy. These ranged from speculations about correspondences between material form and the physical biological structures of our senses and nerves – through statements such as "the horizontal line is pleasing because our eyes are positioned horizontally"[43], and even "light produces an agreeable vibration in the respective nerve group through the regular form of its wave movement"[44] – to general statements about the projecting of the sensations of the body in the process of establishing aesthetic relations with matter:

> I can without difficulty place myself within its inner structure, at its centre of gravity. I can think my way into it, mediate its size with my own, stretch and expand, bend and confine myself to it.[45]

In a particularly interesting passage in relation to Marx's conceptions of tool-organ prosthesis and technology (remembering the discussion in Chapter Three), Robert Vischer described the particular type of empathy at work when we use tools:

> We invent working, driving, primordial figures, derived from the created world, figures who treat things as such simply as an appendage of themselves, very much as I feel a stick to be an extension of my arm and an increase of my power. This is a special sense of form [*Formgefühl*], which, like a foreign shoot grafted onto pure self-feeling, can be described as a continuation of it.[46]

In this passage Vischer directly anticipates some of the mirror neuron cognitive mapping research discussed in the last chapter, which shows how our mental maps of the space of our body, and the space around our body, is literally incorporated in tool use.

If Vischer was here recognising the extent to which our conception of self is an active process of production, for Marx, too, there was no “natural” or “normal” condition of humanity. He too sees the species as being self-consciously productive in the world. That is to say, humankind produces itself as species, it produces its world: as such, it produces its own self-consciousness. This consciousness is the opposite of matter, but also identical with it. This is because for Marx consciousness emerges out of productive material sensuous activity. He states that “production thus not only creates an object for the subject, but also a subject for the object.”[47] Again, Marx paraphrases the elder Vischer’s book on *Aesthetics*, noting “the beautiful exists only for consciousness … beauty is necessary in order that the spectator may merge with it [matter]”[48] – and, again, “that the enjoyment of the beautiful is immediate, and that it requires education would seem to be contradictory. But man becomes what he is and arrives at his own true nature only through education.”[49] Quoting Schiller, Marx notes that “beauty is simultaneously an object, and a subjective state. It is at once form, when we judge it, and also life when we feel it. It is at once our state of being and our creation.”[50]

When Marx asserts that “man is affirmed in the objective world not only in the act of thinking, but with all his senses,”[51] he is returning to an aesthetics of the human body as a way of developing Feuerbach’s materialist critique of Hegel beyond the limits of either materialist and idealist philosophy. The objectification of reality, the projection of man’s subjective forces and abilities, is itself a material process for Marx. So when he declares, “all *objects* become for man *objectifications of himself*,”[52] and “the sense of an object for me goes only so far as my senses go,”[53] he seems to be thinking in ways very close to Schmarsow. This can be seen when he writes “the spatial construct is, so to speak, an emanation of the human being present, a projection from within the subject.”[54] Similarly, when Marx suggests that “the senses have their own history. Neither the object of art nor the subject capable of aesthetic experience comes of itself”[55], and again “the senses have become theoreticians in their immediate practice”[56], and “the forming of the five senses is a labour of the entire history of the world down to the present,”[57] he seems to be laying

the philosophical basis for why, as Schmarsow noted, there is a dialectical history of the sense of space. Equally, the empathy theorists were in effect engaged in the kind of intellectual work – i.e. a detailed historical study of our historical forms of body sensibility – that Marx seems to call for (think for instance of his comments regarding the need for "a critical history of technology"), and which, in terms of the sense of space, Lefebvre would later interpret as "rhythmanalysis".

More generally, it was in unravelling the animistic nature of the commodity that the structures of a panpsychic aesthetics would be so productive for Marx. The commodity is for Marx "a very queer thing, abounding in metaphysical subtleties and theological niceties,"[58] which has, he suggests, "a mystical character."[59] The commodity, Terry Eagleton notes, is:

> ... a kind of grisly caricature of the authentic artefact, at once reified to a grossly particular object and virulently anti-material in form, densely corporeal and elusively spectral at the same time. The commodity for Marx is the site of some curious disturbance of the relations between sense and spirit, form and content, universal and particular: it is at once an object and not an object.[60]

Marx developed this analysis in order to establish the basis from which to rewrite history, economics and philosophy, this time starting from the experience of the sensuous human body – as a naturalism – into its extensions and prosthetics in the form of (class) society. These extensions of the body are for Marx *organically* produced and reproduced by technology (as discussed in Chapter Two), which takes on the "aesthetic" task of engaging with matter. Technology and art therefore play a similar aesthetic role here. Both mediate or bridge the gap between subject and object, between consciousness and matter.

Heinrich Wölfflin states, in line with empathy theory in general, that "our own bodily organisation is the form through which we apprehend everything physical"[61] and that "architecture, as an art of corporeal masses, can relate only to man as a corporeal being."[62] If, as Mark Wigley has observed, "the evolution of technology is the evolution of the human body,"**[63]** then we might expect that as our bodies are extended and transformed by what Marx describes as "the productive organs of man in society, of

organs that are the material basis of every particular organisation of society,"[64] so too is our sense of space. This is not to suggest that our sense of space, and thereby architecture, simply reflects in some linear relationship other socio-technological forces (such as are described by the more mechanistic versions of the Marxist base/ superstructure model), but, rather, are better understood as a part of a cybernetic system of mind. Indeed, as Paul Frankl – one of the second generation of historians to come out of the German empathy school – observed, architectural form is semi-autonomous; we can look to changes in architectural form as the basis for local and temporal changes in metaphysical ideas, as much as the other way around. If, for Marx, it is through the new material organs of industrial technology, and the new immaterial organs of the networks (or ecologies) of capital flows and commodity exchange, that the human being has been most clearly extended and the commodity form "animated", then it is towards these aspects that we should we should turn in search of the next stage of development in thinking about empathy and space.

7.5 Global Networks: Making the Invisible Visible

> We could create the universality of consciousness foreseen by Dante when he predicted that men would continue as no more than broken fragments until they were unified into an inclusive consciousness. In a Christian sense, this is merely a new interpretation of the mystical body of Christ; and Christ, after all, is the ultimate extension of man ... I expect to see the coming decades transform the planet into an art form; the new man, linked in a cosmic harmony that transcends time and space, will ... become an organic art form. There is a long road ahead, and the stars are only way stations, but we have begun the journey.[65]
> [Marshall McLuhan]

Roy Ascott has suggested that art in the twentieth century was preoccupied with the question of making the invisible visible.[66] *Locally Available World unseen Networks* certainly matches that description. Better known by its acronym, *LAWuN* is a project that Archigram member David Greene has been working on for the last forty years. It is work that seeks to project architecture away from matter – i.e. away from building and towards pure network, pure event-information-space. Recent manifestations of the work have for example been based upon live performances and mobile phones. Older manifestations

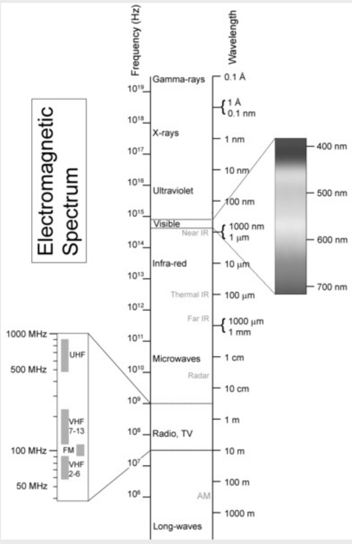
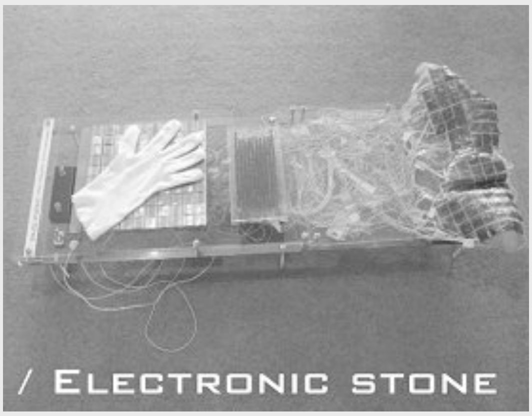


Figure 7.1. The electromagnetic spectrum. Architecture has tended to focus on frequencies of visual light, but this starts to expand in the work of David Greene and others.
Figure 7.2. David Greene and Michael Barnard, Invisible University-The Infraneutral Electrical Aborigine, 1974.

Figure 7.3. A scaffolding frame in a field, adjusted photograph by David Greene, LAWUN Project 2 (1972): "The nearest thing to a village or town or building that should be allowed." It is I think significant with regard to Greene's project that the Hegelian, Alexandre Kojève, would suggest that if post-historical man became animal again, he would build like a spider, constructing networks, cages, scaffolding, and bridges.

Figure 7.4. Greene continues to develop LAWUN projects, and in the 2004 exhibition in a window of the Selfridges store on London's Oxford Street, included the work of several digital artists and students, including research from my Polytechnic design studio: Fig. 7.5. *The Electronic Stone* by Chris Gotsis (2005).



typically featured “Electric Aborigines”: technologically-extended nomads who would travel with their own prosthetic environments.

According to Greene, fixed, permanent architecture will be reduced to “a servicing frame in a field waiting to be used or built upon. Very concentrated. The nearest thing to a village or town or building that should be allowed.”[67] For him, the real architecture here happens at the interface of the body and the ether of communication networks encompassing the planet.

LAWuN remains a highly contemporary project,[68] even whilst this work is very openly indebted to mid-twentieth-century communications theorists such as Marshall McLuhan, who in turn was indebted to Gregory Bateson’s ecological conception of communications media. At the same time, we can explore the pre-occupations within LAWuN and find useful affinities that are much older. If the medieval cathedral used the experience of one immaterial medium – light – in conjunction with matter to ask theological questions through architectural experience, is Greene perhaps just doing the same but with a three-fold increase in wavelength from visible light waves to the realm of invisible radio waves?

In order to approach this question, it is useful to return briefly to Hegel’s theory of aesthetics. For Hegel (simplifying enormously), art was an expression of the development of spirit/mind through time. For the Hegelian “Idea” to be fully expressed, it was necessary for it to overcome matter, which is why for Hegel architecture was the lowest of arts.[69] Hegel suggested that the last stage of architectural development was the Gothic interior, which he described as a chamber of mind, and “the concentration of essential soul life which thus encloses itself in spatial relations.”[70]

In fact, it is in relation to Hegel that Cornelis van der Ven makes what is I think his most suggestive observation, which is that if architectural theorists took Hegel’s hierarchy to heart – and so long as architecture only thought of itself as an empathic relation between the corporeal human body and the mass of a building – then architecture would stay at the lowest level. However, to the extent that architecture is able to re-theorise itself as being primarily about the empathic relation between the living body and *space*, architecture might perform a dramatic dialectical jump! By redefining architecture as not just an, but *the,* art of space, rather than an art of substance, the way can be found to

Pantheistic images within contemporary culture

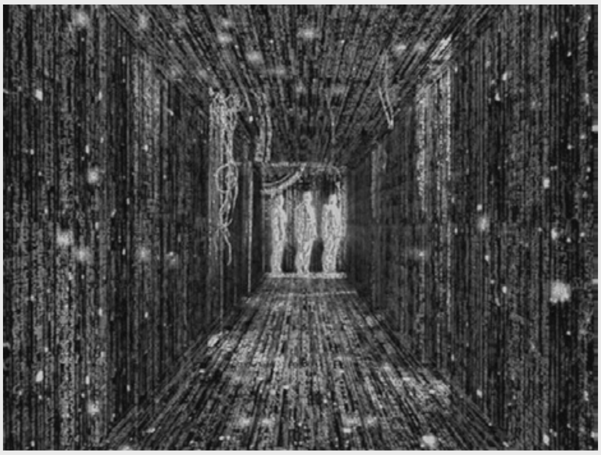


Figure 7.6.The Emperor, from Star Wars (1977).
Figure 7.7 The Matrix (1999)
Figure 7.8 Discredited (though very popular) images of Kirlian field photography.

position architecture as the highest rather than lowest of art of a Hegelian aesthetics. Within such a schematic, we can conclude, immaterial architectural projects, such as Greene's LAWUN, are the most Hegelian architectural projects of all!

There is, however, yet more at stake in these issues than might at first appear. Greene is not alone in working with what I argue are the *spiritual forms* of invisible networks or fields. A pantheistic cosmology, which in its general form imagines the universe of matter to be interpenetrated with fields or networks of energy or spirit centred upon the active human body, is a surprisingly frequent image in contemporary global culture, and can be found in manifestations as varied as the 'Jedi force' in the Star Wars films to the dominance within contemporary management theory of what we might (following Slavoj Zizek) call 'Wall Street Buddhism'.[71] More than just a by-product of entertainment technology, or a commodification of eastern religions, this panpsychism has had, as I have suggested, a particularly productive and interesting history, drawing together in perhaps unexpected ways the philosophy of Karl Marx and the emergence of the discourse around space in architecture. In Marx, a form of panpsychism is used to describe the quasi-mystical properties of the commodity. In modern architecture, spectres of Hegel's *Geist* still animate the concept of space.

7.6 Empathising with Abstraction - Metropolis and Mind

If Worringer, Giedeon and Gropius developed and disseminated one spatial discourse out of empathy theory into architecture, then a second related discourse – also grounded in a "post-Hegelian" theory of formal alienation – emerged in sociology. Georg Simmel, perhaps more than any other thinker, took on the relation that empathy thinking had articulated between architectural and urban form and mental form. He conceived of the city as "an objective mind", an expression of what he described as "the great project of the mind, to overcome the object as such by creating itself as an object, and, thereby enriched, to return to itself."[72]

For Simmel, there are important correspondences between the forms of experience, the forms of society and the forms we make – specifically the form of the modern metropolis.[73] Simmel suggests that "the city is not a spatial entity with sociological

consequences, but a sociological entity that is formed spatially,"[74] and hence the metropolis provided the particular conditions in which the 'space' of concrete experience (superindividual 'society') and the 'space' of inner experience (individual subject) are mapped onto each other. This mapping is a 'pattern that connects' if ever there was one. In fact, we might add to our previous definition of the metropolis as the pattern that connects nature and culture, a second definition: the metropolis today is the pattern that connects the individual and the multitude.[75]

Frankl's suggestive remarks concerning the active role that physical form (as material concepts) might have in producing metaphysical ideas were given further resonance by Simmel, and were soon tested for political potential in the cauldron of Weimar Germany, where the concept of form oscillated headily between aesthetic and sociological registers. For an activist architect like Bruno Taut, this socio-aesthetic opening of form suggested that "architecture will thus become the creator of new social forms."[76] Taut was no doubt encouraged in this approach by the (heavily Simmel-influenced) architectural theorist, Adolf Behne, who, as Forty puts it:

> ... attempted to reverse the prejudice against form as inherently asocial by suggesting that 'form' was the means by which individuals would acquire consciousness of the collective nature of the society to which they belonged.[77]

In a fascinating passage that captures many of the possibilities and problems associated with modernist architectural theory's attempt to work through the demands placed upon it, in part through this dual conception of form, Behne stated:

> ... form is nothing more than the consequence of establishing a relationship between human beings. For the isolated and unique figure in nature there is no problem of form ... The problem of form arises when an overview is demanded. Form is the prerequisite under which an overview becomes possible. Form is an eminently social matter.[78]

We could easily replace "form" with "pattern" in the above passage and make out of it an interesting cybernetic reading. What really stands out is the phrase about "the problem of an overview." This really is a problem, and in fact it is a first-order error: for anyone to

imagine that form or pattern can in itself provide an overview, in and of itself, presumes the kind of detached and transcendental viewing position that so alarmed Bateson when regarding first-order systems approaches. As suggested previously, what is interesting about empathy theory is that it is a second-order aesthetic discourse, in that the observer is always necessarily "in the circuit". However, the kind of formulation that Behne slips into above directly anticipates (and no doubt encourages) the kind of non-reflexive instrumental and determinist use that the concept of form was indeed put up to within certain strands of modernist practice.[79] As Forty concludes with regard to form:

> ... developed in the nineteenth century as a solution to certain specific problems – in particular the nature of aesthetic perception, and the processes of natural morphology – 'form' was an extraordinarily productive concept ... But whether it has been so successful an aid to thought about the different problems confronting architecture in the twentieth century is more doubtful ... it might be said to have had disastrous consequences through its part in sustaining the belief in architectural determinism.[80]

Although, then, as Behne suggests, it is indeed possible to see "a form in humanity, a pattern articulated in time and space,"[81] the challenge would seem to be precisely not to objectify pattern, whether in theory or practice. Although I cannot pursue this point in detail here, it is important to note that Simmel's conception of society as a formal pattern did not just influence architectural and urban thought, but provided the basic premise of sociology in general. As Adrian Forty again notes, "Simmel was promoting sociology as a science of forms."[82] It seems to be a commonplace in recent sociology readers to observe, for example, that Ruth Benedict's seminal anthropological work on *Patterns of Culture* (1934), produced the equivalent of Simmel's metropolitan analysis for pre-industrial social form.[83] Bateson and Mead were of course personally associated with Benedict and her work, and this is one route through which we can connect some aspects of Bateson's ecology of mind approach to social form back to Simmel.

There are also other parallels. The spatial separation that occurs for Simmel between inner and concrete experience is, he argues, repeated within the psychic space of the metropolitan individual. It creates exactly the kind of recursive and self-obscuring pathology produced by the messages (including messages transmitted through the media

of money) between the individual body and the social environment that so preoccupied Bateson half a century later. Simmel famously described how the intensity of nervous stimulation that the metropolitan individual is subjected to leads to the emergence of the blasé attitude of the city dweller. This is best understood as the “growth” of an “extra organ” – i.e. a “distancing organ” in the psychological switch from emotional to rational thought that occurs as a defensive mechanism in the individual to cope with living in what Baudelaire, in a memorable and important phrase for both Benjamin and Simmel, had described as a “kaleidoscope equipped with consciousness.”

McLuhan too refers to Baudelaire, suggesting that the latter:

> ... had in mind the city as corporate extensions of our physical organs. Our letting go of ourselves, self-alienations, as it were, in order to amplify or increase the power of various functions, Baudelaire considered to be the flowers or growths of evil. The city as amplification of human lust and sensual striving had for him an entire organismic and psychic unity.[84]

It should come as no surprise, then, that something closely associated to Simmel’s blasé attitude formed the starting point for media theorist Marshall McLuhan’s analysis of “the extensions of man”, in the next phase of metropolitan development in the post-war period.[85]

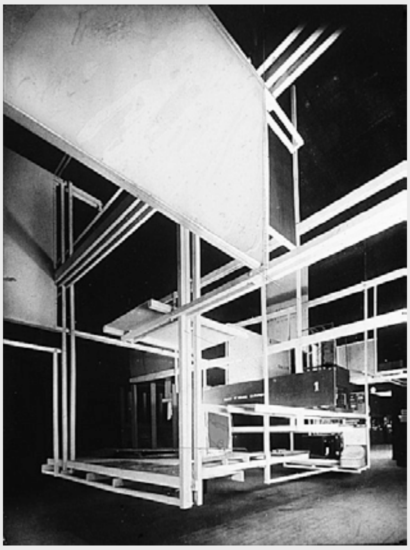
7.7 Network Spatiality

> A building today is interesting only if it is more than itself; if it charges the space around it with connective possibilities.[86]
> [Alison and Peter Smithson]

As Mitchell W. Schwarzer has noted, by the mid-1940s the architectural and art historian, Paul Zucker, felt able to reformulate:

> ... the spatial divisions that Schmarsow had previously given to the three visual arts. Alongside architecture (shaped space and formed mass), Zucker rehabilitated sculpture as a spatial art (formed masses and spaces shaped by them) and added the new category of urbanism (shaped space and organized directions).[87]

Network Imaginaries



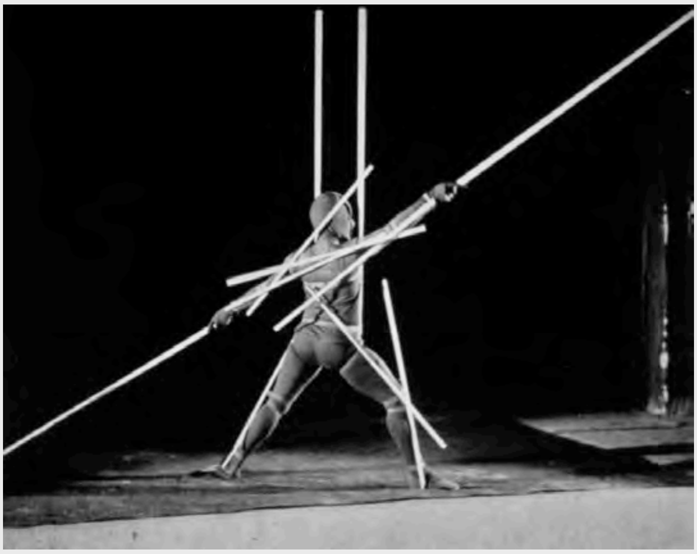


Figure 7.9 Frederick Keisler, ‘Future City’ installation (1937)
Figure 7.10 Oskar Schlemmer, ‘Dance of Slats’, Bauhaus stage (1927)

In these network projects shown above we find an architectural web that ultimately encompasses the planet, in the guise of an interface to, a framework for, or a reification – a making visible and material – of the immaterial networks of modernity. And just as the initial experience of immaterial networks radically develops and extends through processes of alienation the sensuous human body, these environmental interfaces continue to ask questions of subjectivity in modernity, the separation of subject and object, as a dialectic of mind and matter.

However, it is not at all clear, I think, how we should conceive of the utopian architectural network projects. Should these be understood as actual propositions, or should they be understood as ways to use the architectural imaginary to think about things, and to produce concepts, that cannot be formulated in any other way?

Schmarsow's spatial divisions have in fact been revised several more times since being expanded into urban theory in the first half of the twentieth century. Perhaps one of the most important reinterpretations – in that it still very much pertains to aspects of our sense of space – is that already anticipated in the earlier discussion of Greene's LAWuN project: that is, the network.

The network can be seen as a structural figuration of space consciousness in modernity, one of the forms through which we currently imagine and reproduce our relations to society and the world. Indeed, following Manuel Castells, we might say the network is *the cultural form* of global capitalist metropolitan modernity. As an idea, and a conceptual figure, the network has a long intellectual history. As we have seen in Chapter Two and Chapter Three, the network emerged as a concept in eighteenth-century biology, and, by the nineteenth century, images of networks could be found structuring abstract scientific diagrams in physics, biology and chemistry as atomic structures, force fields and bodily circulation systems, and increasingly as concrete realities in the form of town and regional plans, or as transportation, communications and infrastructure systems.

The figure or concept of the network has been very productive in modern times as a tool, as a piece of technology, partly because of the complex formal properties of the network figure: it is potentially endless, isotropic, heterotropic, dynamic, non-centred, centred, multi-centred. And these formal properties allow us to use the network to describe and analyse and produce phenomena as varied as those listed above. We can clearly see the ecological usefulness of the modern conception of the network in Fritjof Capra's description of living systems:

> ... whenever we encounter living systems – organisms, parts of organisms, or communities of organisms - we can observe that their components are arranged in network fashion. Whenever we look at life, we look at networks ... the first and most obvious property of any network is its non-linearity – it goes in all directions. Thus the relationships in a network pattern are non-linear relationships. In particular, an influence or message, may travel along a cyclical path, which may become a feedback loop. The concept of feedback is intimately connected with the network pattern ... self organisation has emerged as perhaps the central concept in the systems view of life, and like the concepts of feedback and self-regulation it is

Figure 7.11 Superstudio, “In the future there will be no need for roads or squares” (1971)

Using concepts that can be productively turned to think upon this utopian network imaginary, Manuel Castells has argued that today our condition might be describes as “increasingly structured around the bipolar opposition of the Net and the Self”, as played out within and between an “opposition between global and local” – or what he calls “the space of flows” and “the space of places”. The “space of flows” is the abstract and yet very real dynamic networks of capital, communications, transport, technology, commodities, etc. circulating around the planet. The term also encompasses our mind’s experience and mapping of this space, and the real physical places dedicated to enabling these flows: “the corridors and halls that connect places around the world”. The “space of places”, by contrast, is the specific, physical, local, historical material world that we live in everyday. Although the space of flows sits “above” and in relation to the space of places, they map onto each other unevenly (see Harvey et al), and unequally.

Cities, argues Castells, are artefacts uniquely and problematically positioned as a mediating interface between these competing spaces: “Cities, as communications systems, are supposed to link up the local and the global, but this is exactly where the problems start since these are two conflicting logics that tear cities from the inside when they try to respond to both, simultaneously.”[113]

Nonetheless, he argues that we need to build between the space of flows, and the space of places, a series of “cultural, political and physical bridges.”[114] These projects anticipate Castell’s demand, for an architecture that connects, mediates, provides an interface between the space of flows and the space of places.

> closely linked to networks. The pattern of life, we might say, is a network pattern capable of self-organisation.[88]

Beyond the descriptive and analytic power provided by its formal properties, the network's importance as a socio-cultural gestalt figure is no doubt also due to its resonance or correspondence with the dominant organisational forms within capitalist society: in other words, the production, circulation and exchange of capital and commodities. Quite simply, mental images or cognitive maps of global networks are produced through the experience of the circulation of capital and commodities, and through communication patterns. For the modern metropolitan subject, our lived everyday encounters with these network environments fundamentally and radically changed our understanding of ourselves in relation to objects, environments and each other. For Simmel, they produced a distinctly extended body and mind:

> A person does not end with the limits of his physical body or with the area to which his physical activity is immediately confined but embraces, rather, the totality of meaningful effects which emanates from him temporally and spatially.[89]

These experiences are something to do with the way we *produce* our own sense of space. In pre-industrial society, every object that an individual was likely to encounter in their lives would come from their immediate world. Each object would thus have a local history, meaning, use value and so on. For the individual in modern industrial society, however, the relationship through exchange to every other object on the market network is radically different in kind. The market network came to be experienced as an extension of the local environment, and experienced as a transformation of the individual's sense of space. Developments within communications technologies, as noted by Marshall McLuhan, similarly intensify our experience of the extensions of the local environment created by market networks, more specifically as extensions of the individual themselves, and are equally radical in transforming our experience of, and sense of space. He suggests that "any extension, whether of skin, hand, or foot, affects the whole psychic and social complex."[90]

Immersion in Networks

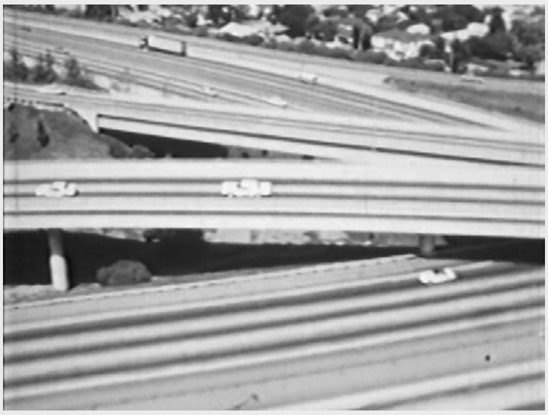


Figure. 7.12-15 Stills from Reyner Banham’s documentary film “Reyner Banham Loves LA” (1972).

The obsession of architectural historian Reyner Banham (“I learned to drive in order to read Los Angeles in the original”) and his contemporaries with the automobile could be seen as an outdated form of object worship, and in a sense it was. But it was also an expression of something else – in fact the clearest possible expression of a particular modern condition: that of occupying a network, in this case a network of roads. We should not, then, think of the object “car” as the actual machine, the end game. The car is just the first level immersive interface to a much bigger assemblage: the entire road network. The car is a means by which man could immerse and extend himself into the network organism as an experiential system: the *man - car - road network*.

McLuhan was influenced by Gregory Bateson in all kinds of ways, and for "media ecologists" such as Paul Ryan,[91] or artists such as Dan Graham, this pair of thinkers constituted the twin columns of a whole new way of thinking about modern global environments. In many ways, McLuhan's conception of the way that media construct messages – for McLuhan, "the 'content' of any medium is always another medium"[92] – owed much to the communicational theories that Bateson (and indeed many others) were working on in the 1950s. For Bateson, it was useful to think about the nature of messages through a theory of logical types, in which "human verbal communication can operate and always does operate at many contrasting levels of abstraction"[93], and "every metacommunicative or metalinguistic message defines, either explicitly or implicitly, the set of messages about which it communicates."[94]

McLuhan made an innovative reading of this basic conception from information theory that a message always contains multiple levels of meaning, some of which concern clues about how to contextualise and interpret a signal. Essentially, I suggest that he used the same structure to think about the way that new media and technology work as new forms of metacommunication themselves, recontextualising the existing field. Like Bateson, and like Marx before that, McLuhan insists that because technologies – which for McLuhan are media – are real extended organs, then it is new media which constantly *reorganise* the entire personal and social body. He suggests that:

> ... the effects of technology do not occur at the level of opinions or concepts, but alter sense ratios or patterns of perception steadily and without any resistance. The serious artist is the only person able to encounter technology with impunity, just because he is an expert aware of the changes in sense perception.[95]

Buildings and cities, too, can be interpreted as media, but they seem to occupy a particularly complex position in McLuhan's model. He notes in general that cities support what the young Marx described as our "species being", our life processes. McLuhan states, in an essay on "Housing: New Look and New Outlook", that:

> ... if clothing is an extension of our private skins to store and channel our own heat and energy, housing is a collective means of achieving the same end for the family or the group. Housing as shelter is an extension of our bodily heat control

Immersion in Networks

Figure 7.16 Moscow Metro Station (1930s)
Figure 7.17 Gants Hill station, east London, on London Underground Central Line (1930s). Public transportation systems offered similar potential for systemic immersion, as a collective subject, and carried with them, through their shared and non-consumerist interface a potential for a quite different social imaginary, as Frank Pick and Charles Holden on the London Underground, and of course the designers of the Moscow Metro, understood clearly.

> mechanism – a collective skin or garment. Cities are an even further extension of our bodily organs to accommodate the needs of large groups.[96]

Whilst buildings and cities are in this basic sense extensions of our metabolisms and our bodies, the other media that buildings and cities frame and enable are also extensions of our nervous systems, and our minds, and some must in a complex way (according to McLuhan's own conception outlined above) take architecture as their content. Interestingly, this reflexive condition of architecture seems to get played out in a very particular set of formulations that can only be understood as concerning a shift in the sense of space. Remembering that, for McLuhan, language in general had initiated a fragmentation in consciousness, he suggests that:

> ... literate man, civilised man, tends to restrict and enclose space, and to separate functions, whereas tribal man had freely extended the form of his body to include the universe. Acting as an organ of the cosmos, tribal man accepted his bodily functions as modes of participation in the divine energies.[97]

However, for McLuhan, the fragmentation that he associates with the technologies of mechanisation starts to be reversed with electronic media. He suggests that "electric circuitry is Orientalizing the West. The constrained, the distinct, the separate – our Western legacy – are being replaced by the flowing, the unified, the fused."[98] This suggests for McLuhan that "the aspiration of our time for wholeness, empathy and depth of awareness is a natural adjunct of electric technology."[99]

There is, I suggest, an important connection between the emerging sensibility that McLuhan is trying to describe in these quotes, and the role that the network played (and continues to play) in the modern architectural imaginary. McLuhan is no doubt astute in associating these shifts in spatiality with the immaterialisation and transformation of production, and social relations more generally, through electronic media. However, given that this shift can be traced back, as I have argued, to the nineteenth century, it seems plausible that what the "electric" presents in a pure and experientially immaterial form (forgetting for a moment that there is an enormously real and material production machine

Network Imaginaries

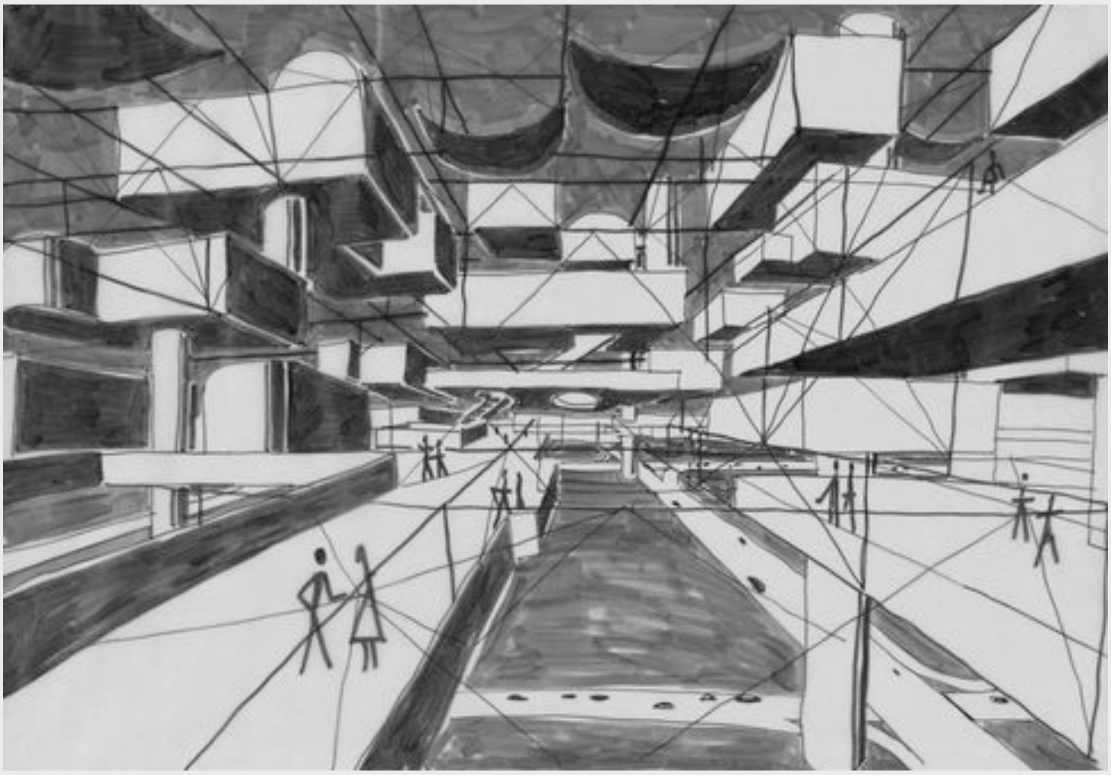
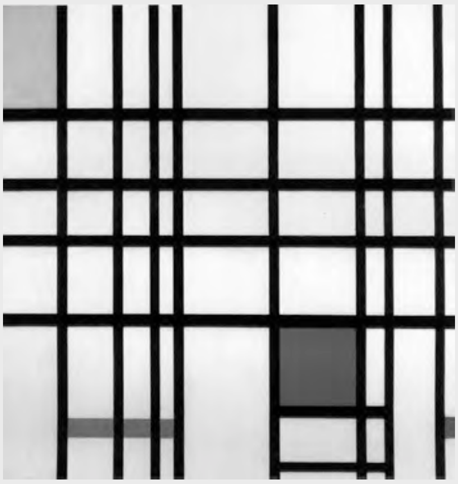
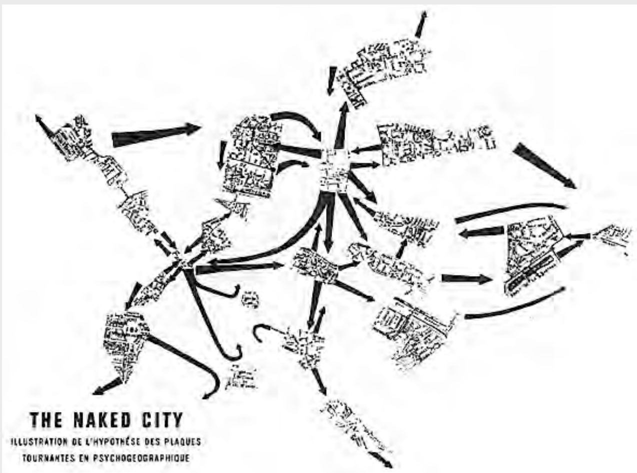


Figure 7.18 Yona Friedman, three dimensional future city studies (1950)
Figure 7.19 Mondrian, Composition with Red, Yellow and Blue (1921)
Figure 7.20 Guy Debour, The Naked City (1969)





that makes “electricity”) is the product of immersion in global production, exchange networks and social relations.

In fact, it seems to me that it is absolutely clear that this shift in the sense of space – through the way that individuals produce cognitive maps to describe their relations to their social and physical environments – can be clearly seen in modernist architectural and artistic production. Whilst there are of course a few major typological precedents for the network which can be found in pre-modern art and architecture, suddenly by the early-twentieth century the network is everywhere. We can feel the presence of infinite networks for instance in the painted grids of Mondrian, where we can find expressed, as van der Ven suggests, “the new spirit, that of space itself, as the visible immaterialisation of form.”[100] We can empathise and project ourselves into dynamic networks in the force-field forms of the Futurists and Expressionists. We can plug ourselves into and wear the endless megastructural frameworks of post-war architects ranging from Constant to Soleri, Archigram to the Metabolists, Friedman to Superstudio. Ultimately, these various endless three-dimensional gridwork studies are I think spectres associated with Alexandre Kojève’s suggestion that if post-historical man became animal again, he would build like a spider, constructing networks, cages, scaffolding, and bridges.[101]

7.8 Ecological Empathy

I started this chapter with a discussion of the concept of empathy as a theory of mind in the work of Lipps, and its shift of the concept into new areas of psychology and philosophy, where it continues to undergo interesting development whilst retaining its original spatial component. One of these strands of development led into phenomenology, where it was taken up in particular by the philosopher, Edmund Husserl, to form the basis of key phenomenological conceptions of perception and inter-subjectivity. For example, Evan Thompson makes a series of observations, following Husserl, along the lines that empathic processes are initiated in every act of perception – in that, whenever we observe an object, we are aware that we cannot see all sides of it. We imagine, at some level, what it must be to perceive the object from other subject positions, in a process described in phenomenological philosophy as *appresentation*.

In fact, Thompson argues that empathy is an extremely significant concept, and is nothing less than "the precondition of the science of consciousness."[102] He states that:

> ... if the phenomenological analysis of empathy and the open intersubjectivity of consciousness is on the right track, then it follows that the naturalistic perspective of cognitive science presupposes empathy as its condition of possibility, in particular the reciprocal empathy by which self and other are concretely co-determined. By this assertion I do not simply mean that cognitive science is an intersubjective enterprise that depends on the shared, pre-theoretic, lived experience of the scientists themselves. I mean something more radical, namely, that the very object of cognitive science – the embodied mind as a natural entity – is constituted as a scientific object through reciprocal or reiterated empathy in the human life-world.[103]

Lakoff and Johnson put the concept of empathy to a related albeit different task. They started in territory normally outside of the scope of naturalistic accounts, although on similar ground to Bateson's later work, by observing that "imagined empathic projection is a major part of what has always been called spiritual experience." They added that:

> ... the capacity for imaginative projection is a vital cognitive faculty. Experientially, it is a form of 'transcendence'. Through it, one can experience something akin to 'getting out of our bodies' – yet it is very much a bodily capacity.[104]

They also suggest that empathy must play a role in what they describe as a theory of "embodied spirituality", recognising what Bateson would insist is the "mental" character of the environment. Here they declare:

> ... the environment is not an 'other' to us. It is not a collection of things we encounter. Rather, it is part of our being. It is the locus of our existence and identity. We cannot and do not exist apart from it. It is through empathic projection that we come to know our environment, understand how we are a part of it and how it is a part of us. This is the bodily mechanism by which we can participate in nature, not just as hikers or climbers or swimmers, but as part of nature itself, part of a larger, all-encompasing whole. A mindful embodied spirituality is thus an ecological spirituality ... [and] requires an understanding that nature is not inanimate and less than human, but animated and more than human ... embodied spirituality is more than spiritual experience. It is an ethical relationship to the physical world ... it is thus

> an activist moral attitude not just towards individuals, but towards society and the world.[105]

I think that this ecological extension of empathy is extremely important and useful in many ways. However, we are essentially talking about complex forms of cognitive mapping, and it is useful at this point to recall the provocative suggestions that Frederic Jameson has made in this direction. This is doubly significant, as Jameson also brings to the fore the role of ideological critique in regard to cognitive mapping, reminding us that there is always a politics behind the maps that we produce, and the individual and collective selves that we thereby bring forth.

Jameson, in his often referenced essay on "Cognitive Mapping", sets out some "possibilities for a new kind of Marxist aesthetic"[106] – one which ideologically examines spatial sensibility, looking for what Louis Althusser described as "the Imaginary representation of the subject's relationship to his or her Real conditions of existence," via what Jameson calls "an extrapolation of [Kevin Lynch's] spatial analysis to the realm of social structure." [107] For Jameson, there is – as Simmel, Kracauer, Worringer, Behne and the second generation of empathy theorists suggested – some kind of correspondence between the forms of society, the forms of individual experience, and the forms of the environment. In fact, I would suggest that the network, as considered above, can be understood as a specific historical form of spatial sensibility, acting in different manifestations as both the "real conditions of existence" and as "imaginary representations". Even more than that, it is also in some way the *ur-form* of spatiality itself, making visible the concept of space and viability of socio-spatial cognitive mapping. The experience of networks help to bring spatiality in general to our cognitive minds.

Returning to the "ecological aesthetics" suggested in different ways by Bateson, Lakoff and Johnson, and Thompson, there are now a few things that can be said. I would suggest that there is an important sense in which the so-called Gaian impulse in general might be thought of as an "inverted global totemism". As McLuhan observed, "the aspiration of our time for wholeness, empathy and depth of awareness is a natural adjunct of electric technology."[108] That is to say, I think, in my view it is our empathy with the metropolis, our "second nature,"[109] and even our empathy with the global abstraction of

the systems and networks of capitalism, that allows us now to see the planet as a single global ecosystem. This is the same condition, albeit reversed, that Bateson described with regard to totemism[110] in certain pre-industrial societies:

> Anthropologically, it would seem that from what we know of the early material, that man in society took clues from the natural world around him and applied those clues in a sort of metaphoric way to the society in which he lived. That is, he identified with or empathised with the natural world around him and took that empathy as a guide for his own social organisation and his own theories of his own psychology. This was what is called ‘totemism’. In a way, it was all nonsense, but it made more sense than most of what we do today, because the natural world around us really has this general systemic structure and therefore is an appropriate source of metaphor to enable man to understand himself in his social organisation.[111]

Our technological ecologies – such as cities, production systems and so on – with which we have “as cyborgs grown” can thus also experienced as extended or external minds, just in the same way as “natural” ecologies. Our ability to form simulations of other minds (people, ecologies, economies) to create internal maps or representations, seems to be critical to the emergence of our self-consciousness as a historical species, and yet it is continually repeated in our individual production of ourselves. We might say that today, paradoxically, the global metropolis “really has this general systemic structure”, however pathological, and that we are indeed using it as the basis of “metaphors” that enable us to see, however inadequately, the natural world around us.[112] The challenge facing modern human culture is to find ways to examine and work with the metaphors that we embody, given that the mismatch between consciousness and mind is becoming more ideologically distorted than ever, through the operations of advanced capitalism.

8 Conclusion: Towards a Critical Urban Ecology

> ... the world is to be comprehended not as a complex of ready-made things, but as a complex of processes, in which apparently stable things no less than the concepts, the mental reflections in our heads, go through an uninterrupted change of coming into being and passing away.[1]
> [Friedrich Engels]

8.1 The Architecture of Autopoiesis

I opened this thesis with the suggestion that the kinds of concepts which architecture produces – through its organising and ordering of matter and bodies in space and in time – are inherently relational and systemic. I argued that the emergence of the discipline of architecture in the Renaissance prefigured the later development of systems theory in general, and did so through its staging of a series of questions concerning whole/part relations via theories and practices of formal composition that included scale, harmony, balance and proportion. On the one hand, we must think of the discipline of architecture that emerged from this historical juncture as an autonomous and autopoietic system, whose meaning remains internal to itself: architecture was and remains at root a discourse about architecture. Equally, of course, architecture is, even whilst autonomous, structurally coupled to all kinds of other discourses – such as law, finance, science, technology and religion – and as such is also physically embedded within the material condition, and informational systems and ecologies of the natural and human worlds.

The concepts that architecture produces as architecture are therefore always in some way also expressive of, and interdependent with, discourses, processes and other cultures beyond architecture. Moreover, we experience and perform these concepts in an extended and embodied condition. Clearly here, when talking about architecture, I do not simply refer to building but to an entire discourse – grounded in thinking about and producing space as a social and material phenomenon – articulated through building, making, writing and drawing. Architecture thus conceived has a dual or dialectical relation to other discourses and material and ecological processes. It is both wholly autonomous

and radically interdependent, at the same time. This means that it is possible for architecture to make available to social experience its very embeddedness within, and as constituting, a complex cultural and material world. But it also means that it is possible for these relations to be expressed in a language that is to a large degree autonomous. Importantly, this relational autonomy means that there is at least the potential for architecture to articulate social and political concepts that cannot be expressed through other discourses – such as law and finance – which dominate the construction and narrative of modern capitalism.[2]

In the first four chapters of this thesis, I traced the ideological and instrumental development of a series of systems theory concepts in discourses linked to the natural, social and built environments, from across the arts and humanities, as well as the natural and social sciences. I drew several conclusions from this part of my study. Firstly, I noted that the concepts that we have inherited to think about our environment – including terms such as nature, ecology, organism, sustainability etc – are all inherently problematic, and require constant critical ideological attention. Equally, each of these terms is incapable in its current form, of thinking through and meeting the tasks that confront us regarding our relation to the broader planetary webs of life and matter. So we have no choice but to use these terms – we have nothing else at present – but need to shape them to new tasks, while developing new concepts too. Finally, I observed that there must be implicit in such a position, a new attempt to describe the world that we find ourselves in, and which we help to produce. I noted that this necessarily “re-enchanted” account (as both David Harvey and Isabelle Stengers have described it) must also include a recognition of what is at stake politically in any such attempt.

Recent theory – notably for example Bruno Latour’s actor-networks, Nigel Thrift’s non-representational theory, and Timothy Morton’s particular strain of Object Oriented Ontology – has become increasingly adept at articulating the extended relations of all kinds of concepts, objects and processes, in ways that breach the boundaries of traditional disciplines and discrete areas of knowledge. These “new materialisms” are all undoubtedly useful, although each has specific limitations.

I have not on the whole dealt directly with any of these recent theories, but instead attempted to develop my own distinct “ecological materialism”. I did so by returning to

consider the emergence of various “philosophies of organism” in cybernetics, systems theory, ecology and the life sciences, in parallel with a reconsideration of Friedrich Engels “Dialectics of Nature” project. In that important collection of notes and papers, Engels argued for a conception of a dynamic materialism whereby “the general nature of dialectics [is] to be developed as the science of interconnections, in contrast to metaphysics.”[3] In addition, then, to introducing the question of architecture and systems theory, my first chapter also framed this very question within a Marxian dialectical method of internal relations.

My return to Engels’ “Dialectics of Nature” project is not at all intended to be a simple restatement of old dogmatic and sectarian disputes within what, even for for most academics, would be seen as rather arcane and marginal areas of Marxist theory. Rather, my task here is to note that some of these questions have simply reopened in recent years due to the development of new ideas and observations about reality. The impetus for this reopening comes from several sources – most notably, systems theory has developed in ways that seems to converge with dialectics, and indeed, seems to require a dialectical approach to resolve certain logical dilemmas, in particular theories of emergence and complexity. However, the impetus is in fact much more broadly based than that.

The standard refutation of the dialectical materialist project is that the dialectical process needs to contain a subjective component, which western Marxists took to be lacking in objective modern science. Today it appears as an irony of history that this position was advanced in Marxist theory, at the same time as the very question of subjectivity, and observer effects, were being raised in one area of science after another. The question of subjectivity has repeatedly arisen in various guises within science and technology studies, and within second-order systems theory in recent decades. I suggest – although I do not have the space or training to develop further here – that the issue of subjectivity in science, rather than being a problem for any “Dialectics of Nature” project, might actually be its point of conceptual re-entry.[4]

Ecological Aestheticians

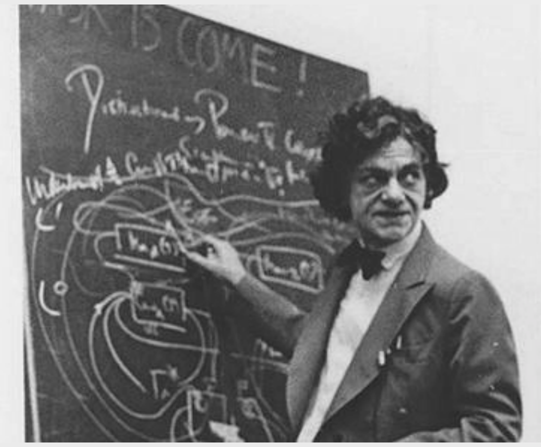


Fig. 8.1 David Bohm, quantum physicist (1917-92)
Fig. 8.2 Stafford Beer, management theorist/ neocybernetician (1926-2002)
Fig. 8.3 Gordon Pask, artist/ neocybernetician (1928-96)
Fig. 8.4 Francisco Varela, cybernetic biologist (1946-2001)
Fig. 8.5 Isabelle Stengers, scientist/critical theorist/philosopher (1949-)
Fig. 8.6 Ilya Prigogine, chemist (1917-2003)
Fig. 8.7 Alexandr Bogdanov, tektologist/bolshevik (1873-1928)

8.2 Our Extended *Oikos*

The encounters that I staged in this thesis between Marxian dialectics, and contemporary neo-cybernetics and complexity theory, occured at several moments through different chapters. Notably, in what I believe to be a novel move, I brought Marxian dialectics into direct relation with Maturana, Varela and Thompson's cybernetic biology account of the organism, and of the way that any organism as a perceptual unity-process "brings forth" a world. In Chapter Three I sketched a "labour theory of cognition" as a means to bring Varela's dialectical theory of cognition, in particular, into a more conventional Marxian account. I also observed that Smith and Harvey's development of a conception of "the production of nature" was preceded by several decades in the neo-cybernetic account of living systems that are always defined through their productive relations with their environment.[5]

Chapter Two to Chapter Five then turned in different ways to think about ecology and cybernetics. Whenever one does this, one is invited, of course, to think in terms of whole systems – their processes, boundaries and interactions – while also thinking about the articulation and exploration of radically new conceptions of mind, life, information and language. In summary, it is worth concluding that there are two discourses that I take to be vital from my study: radical cybernetics and urban political ecology.

The first of these discourses, that of radical cybernetics, as I define it here, refers to work produced in particular by Gregory Bateson, Stafford Beer, Francisco Varela and Gordon Pask, who between them developed a self-reflexive criticism of systems theory's tendency to talk in terms of optimisation, efficiency, control and so on. Andrew Pickering has noted, in a reading which closely aligns with my own, that "the ontology of cybernetics is a strange and unfamiliar one, very different from that of the modern sciences". He writes that whilst the modern ideology and practice of science was fundamentally representational, within this cybernetics group there emerged a radical though marginal research interest which staged a non-representational approach. This was based upon a "hylozoic wonder", and a "reciprocal coupling of people and things", and tried to develop a new philosophy and science of material process. Describing this work as "ontological theatre"[6], Pickering has suggested that this form of neo-cybernetics – as opposed to

mainstream systems theory and ecology – staged a study of “anticontrol”[7] and “an ontology of becoming”[8] that drew back “the veil the modern sciences cast over the performative aspects of the world, including our own being.”[9]

Notably, then, I insist upon a critical philosophical reading of the legacies of cybernetic research that is markedly different to the mainstream technocratic interpretation of cybernetics that has developed in recent decades. The binary oppositions that *do* continue to structure so much contemporary thinking, such as matter and pattern, nature and culture, subject and object, were profoundly problematised in neo-cybernetic research – not just conceptually, but as Pickering has emphasised, through real experimental projects. Cybernetics provided a somewhat unique space for materiality and subjectivity to perform as networks of agency. Across an ecology of practices – art, architecture, psychiatry, biology, robotics, biological computing, cognitive science and even management theory – we therefore find in these neo-cybernetic experiments the beginnings of a reformulation of the project of western knowledge, leading to a different way of thinking about what “things” are, and what we can know about them. The legacies of this project have I would argue, an ongoing and important contribution to make to a new form of materialism today. I have tried to relate much of the material that was consided in my later chapters to this emerging way of thinking about the world.

The second key discourse that emerged from the first four chapters of this thesis is urban political ecology, broadly conceived. Recent writings on urban political ecology (in particular in human geography but also in architecture and planning, landscape urbanism, as well as sociology and philosophy more broadly) have begun to make the case for a comprehensive rethinking of notions of urban metabolism. In this thinking, dichotomies of “natural” and “social” ecologies or “natural” and “man-made” environments, are eschewed. Instead, urban processes are conceived as part of an all-encompassing, open and dynamic metabolic system.[10] As already noted, I have made repeated moves to relate this more Marxian approach with some of the novel insights of neo-cybernetics.

By definition, urban political ecology politicises the ostensibly “environmental” aspects of urban ecological debates and “ecologises” the socio-political and economic dimensions of urban processes and flows. Importantly, urban political ecology aims to be sensitive to describing the “metabolic rift” enacted by capitalist production – namely the

Cybersyn, Salvadore Allende and Stafford Beer

Fig. 8.8 The Cybersyn main hub room, Santiago 1971, designed by Italian interaction designer Gui Bonsiepe. There has been a consistent if marginalised engagement between marxist thinking, systems theory and ecology. Perhaps most notable is the Cybersyn project – a collaboration between British cybernetician Stafford Beer and Salvadore Allende's Chilean socialist project – which formed an extraordinary anticipation of the potential that activists see today in web 2.0 distributed network infrastructure. Upon election in 1970, Allende invited Beer to set up a network of telex machines distributed throughout the country's major factories and community centres, providing the world's first working internet-like social network. The project explored how such a system might provide the basis of a "distributed democracy" or bottom-up model of a planned economy.

During this period Chile provided an extraordinary hothouse for radical systems theory, bringing together Beer, and the local cybernetic biologists Humberto Marurana and Fransisco Varela. The Cybersyn network's greatest moment was said to be in out-manoeuvring a US led attempt by foreign lorry drivers to lay siege to Santiago. In the CIA/General Pinochet coup of 1973, Allende and the team of cyberneticians were all assassinated, and the Cybersyn network destroyed. Beer was by chance back in England at the time. Describing the Cybersyn system, Beer stated that:

> We have developed a system on our own. What you are about to hear today is revolutionary – not only because this is the first time that this is applied in the world – it is revolutionary because we are making a deliberate effort to give the people the power that science gives to us, enabling them to use it freely.

disconnect between social, economic, and environmental worlds. Our metabolic rift thus conceived is not a simple technical problem that might be solved through narrowly defined systems design responses: instead, re-imagining our entire relation to nature becomes, according to this analysis, a crucial political activity today.

Political ecology as a discourse offers a broad conceptual framework within which to research a democratic and critical metabolics, and would itself I think benefit from radical cybernetic and ecological aesthetic expansion. For Neil Smith,

> ... political ecology provides a powerful means of cracking the abstractions of this discussion about the metabolism or production of nature. Rooted in social and political theory it is also grounded in ecology ... When complimented by an environmental justice politics, which is ... more politically activist in inspiration, political ecology becomes a potent weapon for comprehending produced natures.[11]

One of the novel contributions that I believe that I have made in this thesis, is to bring together a radical neo-cybernetic ecology of mind with the kind of explicit socio-politicisation of urban ecological thought found in urban political ecology. There is, I would suggest, important intellectual work that can be done straight away in this conjoining. Urban political ecology can be used to frame a questioning of the social and political construction of the real that is enacted in both the radical and the technocratic tendencies in ecological systems design and theory. Equally, the insights of neo-cybernetic and complexity theory into the way that systems (including capitalism) maintain themselves, while also under certain conditions undergo radical reorganisation, can reinforce more classically Marxian accounts of evolutionary and revolutionary change.

The synthesis of urban political ecology and radical cybernetics that I propose does in fact revisit territory that can be found in nascent form in Engels' notes on the *Dialectics of Nature*. In a rather brilliant passage that directly anticipates contemporary theoretical and practical concerns, Engels stated:

> Let us not … flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel out the

Friedrich Engels: Dialectics of Nature

Fig. 8.9 Friedrich Engels (1820-1895)

> first. The people who, in Mesopotamia, Greece, Asia Minor, and elsewhere, destroyed the forests to obtain cultivable land, never dreamed that by removing along with the forests the collecting centres and reservoirs of moisture they were laying the basis for the present forlorn state of those countries. When the Italians of the Alps used up the pine forests on the southern slopes, so carefully cherished on the northern slopes, they had no inkling that by doing so they were cutting at the roots of the dairy industry in their region; they had still less inkling that they were thereby depriving their mountain springs of water for the greater part of the year, and making it possible for them to pour still more furious torrents on the plains during the rainy seasons ... Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – but that we, with flesh, blood and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other creatures of being able to learn its laws and apply them correctly.[12]

In this passage Engels seems to be anticipating a language of political ecology, on the one hand, and of complex systems theory ideas – such as emergence and recursive feedback in referring to "the second and third places" – on the other.

8.3 Emergence and the Rheomode

The concept of emergence – as referred to above – has therefore surfaced repeatedly during the course of my research, and was approached from several directions in different chapters. More broadly, the question of the ontological status of emergence is becoming key to much of the debate in new materialist discourse. In my discussions around this concept, I drew upon thinkers – notably Bertell Ollman, Richard Levins and Richard Lewontin – who have considered how a process-dialectical approach might resolve some of intractable issues faced when trying to account for strong and weak emergence in the terms of classical logic. In conclusion, I would re-affirm this position. The theorisation of emergence is perhaps one of the clearest cases where a renewed Marxian dialectics might make significant contributions to contemporary materialist debate. In a particularly clear and useful passage, Roy Bhaskar has suggested that:

> In emergence, generally, new beings (entities, structures, totalities, concepts) are generated out of pre-existing material from which they could not have been deduced. There is a quantum leap, or nodal line, of (one feels like saying) the materialised imagination ... akin to that occurring in the ... transforms of the rudimentary epistemological dialectic ... This is matter as creative, as autopoietic. It seems, if it can be vindicated, to yield a genuine ontological analogue of Hegelian preservative determinate negation. It consists in the formation of one or other of two types of superstructure (only the first of which has generally been noted in the Marxist canon), namely, by superimposition or intraposition of the emergent level on or within the pre-existing one – superstructuration or intrastructuration respectively.[13]

I concur entirely with Bhaskar's reading here, and again when he goes on to note – in terms similar to Harvey and Lefebvre work on relational space-time and rhythmanalysis respectively – that:

> Emergence entails both stratification and change ... emergent entities and causal powers. But if ... all changes are spatio-temporal, and space-time is a relational property of the meshwork of material beings, this opens up the phenomena of emergent spatio-temporalities. There are two paradigms here, both instantiated in reality ... relata of a new (emergent) system of material things and/or ... new (emergent) relata of a pre-existing system of material things. In either event they establish new 'rhythmics', where a rhythmic is just the spatio-temporal efficacy of the process.[14]

An important aspect of my concluding thoughts concerns our cultural need to develop a popular conceptual language and set of conceptual metaphors capable of communicating and working with a dialectical conception of space-time, and dealing with problems like emergence. As I have shown in the previous chapters, both Gregory Bateson and the theoretical physicist David Bohm suggested that we needed to confront these kinds of questions through a consideration of how we might consciously "evolve" our very language and aesthetic sensibility. Both suggested that this project must lead to some kind of paradigmatically aesthetic reformation of, or extension of, science. Gregory Bateson's work in this regard has been described tellingly as "ecological aesthetics". David Bohm called his project "the rheomode". I will consider both of these terms further,

as I ultimately wish to argue in this conclusion that architectural research can serve to revitalise and contribute to these intellectual projects today.

Bohm suggested that many of the contradictions and paradoxes that arise when physicists try to formulate accurate descriptions of “matter” (and indeed “mind” and “form”), arise from the structures of everyday western language, coupled with the reductive ideology of modern scientific method. For Bohm, western languages tend to privilege nouns, and as a result construct for us a perceived world of discrete subjects and objects. Our language obscures the fundamentally dynamic and interconnected process-based nature of “what is”. Reality, Bohm insisted, is instead a process of differentiated wholeness. He wrote that:

> ... the notion of a permanent object with well defined properties can no longer be taken as basic in physics ... Rather, it is necessary to begin with the event as a basic concept, and later to arrive at the object as a continuing structure of related and ordered events.[15]

Bohm suggested that we should start by assuming “that what is, is movement itself” – and therefore that if we observe this field of movement, then “what is observable is the set of relatively fixed invariants in this movement plus their relationships to the movement as a whole.” Bohm declared:

> Classical physics says that reality is actually little particles that separate the world into its independent elements. Now I'm proposing the reverse, that the fundamental reality is the enfoldment and unfoldment, and these particles are abstractions from that. We could picture the electron not as a particle that exists continuously but as something coming in and going out and then coming in again. If these various condensations are close together, they approximate a track. The electron itself can never be separated from the whole of space, which is its ground.[16]

Bohm imagined a new verb-based form of language, which he called the “rheomode” (from the Greek word for flow). He hoped that such a language might make it easier for us to see, describe and understand this kind of dynamic unfolding wholeness. In discussing these ideas, Bohm noted that he was influenced by two philosophical schools:

Whiteheadian process thought, and Hegelian-Marxist dialectics. Bohm suggested that if it were possible to reformulate quantum theory in rheomodic terms, then it might move beyond the paradoxes that characterised its standard interpretation: indeterminacy, non-locality, wave-particle duality, the role of the conscious observer etc.

Bohm's colleague David Peat has since noted that Bohm's collaborators and students struggled to work with the "rheomode" – one cannot after all just invent a new verbal language. Equally however, he did make some fascinating insights and progress. Notably, in his last year, Bohm – and thereafter more extensively David Peat – held a series of dialogues with members of the Blackfoot tribe of North America, whose language was found to align with Bohm's notion of one structured around seeing a world of dynamic processes rather than objects and subjects.

Bohm actually liked to experiment mentally with all kinds of imagined physical "prosthesis" to develop metaphors that could help him and others conceive of the processes of the so-called "holomovement". These thought experiments included holograms, rotating cylinders of glycerine, computer video games, fishtanks – and his favourite metaphor, apparently was ballet. Peat and Bohm have both recounted in this regard the famous anecdote that Einstein used to need to squeeze a rubber ball whilst thinking about relativistic problems.

I suspect that Bohm, in his use of these metaphors, was actually feeling himself towards a more material and embodied form of the "rheomode". Indeed, Bohm's use of metaphors can in some sense be understood as attempts to construct new embodied concepts through these kinds of processes. It is precisely in this sense that I believe that there is interesting work that can be done today regarding ecological aesthetics. Art and architecture can produce concepts which can be experienced directly, but which are otherwise ineffable, invisible and incomprehensible. It might be the case that new mental paradigms regarding our ecological condition, and the material world around us, can only emerge after we develop new ways of imagining material process and organisational transformation. In this sense, architecture has some critical work to do as an autonomous practice, and by this I mean autonomous even from the act of building. Such a project would involve the exploration of cognition and space-time pattern and order, so as to

produce abstract conceptual metaphors about space, time, matter, energy, process, metabolism, emergence.

In Chapter Five, I noted in concluding that the cognitive theorists George Lakoff and Mark Johnson have argued that because mind is both embodied and empathic-mimetic in a fundamental way, all of our conceptual structures are ultimately “metaphors” abstracted from bodily experience and re-networked. In Chapters Six I then further reviewed a series of contemporary ideas concerning the way that this process actually works – i.e. how the embodied brain empathically maps and experiences the environment within which it is embedded and extended.

The human embodied brain is a pattern recognition and copying organism. The embodied brain perceives through its interactions a certain range of differential patterns unfolding in the world around it, and in doing so internalises aspects of these in complex ways that literally plastically reorder the material organisation of the brain. The patterns that we produce and project into the world are, in this real sense, also re-internalised. We then reuse and adapt the structures and categories developed from sensing, perceiving and acting, in order to be able to develop more abstract conceptual thought. So, in constructing and transforming our world, we really do in some way construct and transform parts of our selves.

There is, clearly, a lot at stake in how we conceive of our mode of being in the world. It is not simply a question of achieving an accurate “objective” understanding of how our minds and environments interact, but also, and more importantly, a political project that ties together our demands concerning our environments with our political demands for new forms of “post-alienated” or “re-enchanted” consciousness.

8.4 Ecological Aesthetics: A Critical Metabolics

I have come to the conclusion that a language of relation, process and metabolism would seem better able than existing concepts – of say matter, or nature, or even systems (which is perhaps too contaminated with instrumental associations) – to provide an

account of the differentiated dynamic unity of *what is*, even whilst describing the specificity of human processes enfolded within this. “Our world is an open systemic entropic totality,”[17] Bhaskar notes.

If David Bohm proposed a rheomodic language in response to developments in theoretical physics, Gregory Bateson made a similar attempt to develop an ecological language, following his observations of living, social and technological systems of all kinds. Bateson argued – in a passage that I read whilst recalling the philosophy of relational space-time described in Chapter One – that:

> ...language continually asserts by the syntax of subject and predicate that ‘things’ somehow ‘have’ qualities and attributes. A more precise way of talking would insist that ‘things’ are produced, are seen as separate from other ‘things’, and are made ‘real’ by their internal relations and by their behaviour in relationship with other things and with the speaker. It is necessary to be quite clear about the universal truth that whatever ‘things’ may be in their ‘pleromatic’ and thingish world, they can only enter the world of communication and meaning by their names, their qualities and their attributes (i.e. by reports of their internal and external relations and interactions).[18]

Both Bohm and Bateson insisted that there was a relation between understanding the shift in the conception of mind and form in their theories, and understanding the nature of ecological crisis. Both related their formulations of new conception of “order”, of mind and matter, and the questions of “what is self?” and “what is environment?” Bohm and Bateson suggested that misconceptions in the way that we think of ourselves as isolated and distinct selves, and our minds as isolated personal phenomena located inside our heads, are in some sense pathological – and that these same pathologies can be found at the root of broader global ecological crises.

In order to understand Bateson’s conception of ecological aesthetics, it is first necessary to recap his broader ecological conception of mind. Writing in 1975, Bateson noted that “you and I are so deeply acculturated to the idea of ‘self’ and organisation and

species that it is hard to believe that man might view his relations with the environment in any other way."[19] Reflecting upon Bateson's position, William Kaizen has recently argued:

> ... if McLuhan takes technology to be 'extensions of man', Bateson goes further. He gives up any notion of man, redefining the self as an expanded mental field in which the subject and its objects are no longer separable. For Bateson, 'mind' is no longer bounded by the individual body, becoming a conjunction of self and world produced through communicative ecologies.[20]

Ecological aesthetics is the name given by Peter Harries-Jones to a broad research study that can be found in Bateson's later work, and in my formulation of it here here I am indebted to Harries-Jones' commentary. Ecological aesthetics can broadly be understood as Bateson's fascination with the way that living systems have an informational aspect through the very ways that their material processes interact. Bateson believed that a dialectical process organised around a logic of abduction could describe many recursive systems. Bateson suggested that abduction was analogous to the way that a moire pattern emerges out of the interaction of two other pattern fields, when seen from a specific point of view. Abduction was for Bateson a ubiquitous process in the living material world, and described the way that patterns of matter interact with and copy bits of each other. Abduction constituted something like a metabolic logic for him. But it was also key to understanding human perceptions of the world, and this he felt that the study of it could lead to a new epistemological paradigm which could beneficially inform human actions in the world.

For Bateson, educational developments were key. Ecological aesthetics for Bateson was about developing empathy and understanding for the "non-intuitive" behaviour of complex feedback systems, and this can only come through staging social and ecological experimental engagements:

> ... the problem of how to transmit our ecological reasoning to those whom we wish to influence in what seems to us to be an ecologically 'good' direction is itself an ecological problem. I believe that ... our greatest (ecological) need is the propagation of these ideas as they develop – and as they are developed by the (ecological) process of their propagation ... the ecological ideas implicit in our plans

> are more important than the plans themselves, and it would be foolish to sacrifice these ideas on the altar of pragmatism.[21]

For Bateson, the wider consequences of not confronting the issues that he raised were profound and disturbing. In a highly suggestive passage he wrote:

> You decide that that you want to get rid of the by-products of human life and that Lake Erie will be a good place to put them. You forget that the eco-mental system called Lake Erie is a part of your wider eco-mental system – and that if Lake Erie is driven insane, its insanity is incorporated in the larger system of your thought and experience.[22]

8.5 Restructuring the Ecology of a Great City

Over the last two hundred years, the effects of human activity – and specifically capitalist production processes – have it seems reached into and touched almost every pore of the planet, and in doing so have coupled with and transformed much of it in the process. It is important to note that there is nothing inherently good or bad about such extensive activity. All kinds of other living species also have or have had a similar global reach and transformative inter-penetration – not least the bacteria at work in our own bodies, and which are even integrated into our very cells.[23] Our extended reach into the web of life on this planet is also in important ways an extended communication with the natural world, and it should not be simplistically abhorred (as can be the case in some ecocentric discourse). The living planet is characterised by a dynamic, evolving co-production of reality, a series of nested metabolic processes. These typically tend to self-organise into meta-systems that stabilise and self-regulate – as famously described by James Lovelock in *Gaia* – but which are nonetheless are frequently, necessarily and productively *far from equilibrium* – as described by Ilya Prigogine and Isabelle Stengers. Adjectives such as “harmonious” and “balanced”, which can often be found in econcentric literature, are in this sense not particularly helpful, and can even be downright misleading.

However, having pointed this out, it is clear that capitalist production systems have taken on particularly pathological, dominating and instrumentalising forms with regard to

the well-being of other life on the planet we share. Moreover they have possibly initiated a series of processes that are at the very least challenging to the future of human civilisation, and damaging to the growth of individual and collective selves. Whilst we need to dismantle and/or transform the conceptual opposition between nature and culture (and at the same time that between natural and social science, and the humanities and sciences), we must guard against the mistake thereby of absolving ourselves from responsibilities towards the non-human world. Whilst we might challenge some conceptions of what nature is, this does not at all mean that there is nothing to be valued there, as some contemporary interpretations tend to suggest. The conceptual challenge confronting us is in some ways properly post-humanist, in that we need to explore what are as yet fleeting impressions of new ways of producing or performing our individual and collective eco-mental selves as flexibly immanently revealed within, and not enframing of, a broader web of life and poetic technology.

As I noted in Chapter Seven, there is a dialectical – and indeed in many respects paradoxical – relationship between the "metropolitan" mental forms that are produced by modern globalisation processes, and our ability to recognise the planet as a dynamic web of interconnected and networked systems: our extended *oikos*. Just like the embodied subject, as a society too our perception is closely connected to our practical action. We only see the world as we change it in some way. Our growing recognition of the complexity of the non-human ecologies around us is closely related to our very transformations of those environments. There is then a tragic paradox here, in that following Bateson – and indeed Francisco Varela and Stafford Beer – we must recognise that like any complex system, *our metabolism is our cognition,* and we can only know the world that we engage with. It would seem that the "observer effects" that our contemporary global forms of capital accumulation take on have aspects that are profoundly damaging with respect to the planet that we share and rely upon; this is damaging to both ourselves, the nature that we produce, and all kinds of entirely *other* eco-mental systems with which, and within which, we dwell.

Equally of course, our human metabolism, in the widest material and immaterial sense, is by now so inextricably coupled and intertwined with all kinds of extra-human planetary ecologies, that we cannot simply withdraw either. To withdraw, were such an act

conceivable, would itself initiate all kinds of ecological crises. Rather, we need to move forward in a manner as open as possible to more biodiverse, progressive, sustainable and socialised futures.

Gregory Bateson pointed out that thinking about our relationship to the non-human world is itself an ecological problem of personal, social and planetary dimensions. Any such description must start out from the fact that it is always “us” that is describing the system in the first place – we are always in some way within the ecology being described. Conceiving of this relation in the wrong way, Bateson suggested, constituted the primary epistemological error of western civilisation,

In several places in this thesis I have referred to what Marx described as the metabolic rift that capitalism instantiates. In other places, in an often parallel narrative, I described the epistemological rift that Bateson so keenly felt. It seems evident to me that Bateson lacked a Marxian perspective on what was at stake politically in his work. Nonetheless, he did become increasingly political as he got older – both in terms of environmental politics, but also, interestingly, in considering the contribution his conception of an ecology of mind might make to *planning* the development of cities and cultures.

In a fascinating intervention in 1970, Bateson organised a workshop with the New York City Planning Department, to try to teach the planners a more ecological – in the broadest sense – way of thinking about the city. Bateson submitted a paper – *Restructuring the Ecology of a Great City* – which was subsequently published and revised in various places. Whilst conventional sustainable design theory today might suggest that we need to reduce waste, and be more efficient in our use of resources, in this paper Bateson suggests that there are problems with thinking in terms of concepts such as efficiency, at least in any narrowly defined way.

Bateson started his paper with an extremely useful formulation regarding the goals of any ecological critique of industrial society. Postulating what “a healthy ecology of human civilisation” in relation to the rest of the planet might be, he suggested that our goal is to achieve the following socio-ecological condition :

> ... a single system of environment combined with high human civilisation in which the flexibility of the civilisation shall match that of the environment to create an ongoing complex system, open-ended for slow change of even basic (hard-programmed) characteristics.[24]

This is, I suggest, a singularly useful conception. Firstly, Bateson affirmed that we are talking about a "high" human culture. This is no simple rejection of modernity. He notes in passing – in contrast to some of the more nostalgic and reactionary theorists that can be found in the green movement – that "it would not be wise (even if possible) to return to the innocence of the Australian aborigines, the Eskimo, and the Bushmen. Such a return would involve loss of the wisdom which prompted the return and would only start the whole process over."[25]

Bateson insists that to meet his criteria a "very great flexibility will be needed."[26] His insistence upon the importance of understanding flexibility might easily be mistaken for a simple truism: of course flexibility tends to be valorised positively – why would one not think that flexibility is better than inflexibility. However, such a commonsense reading misses much of importance in this discussion. For Bateson, "the pathologies of our time may broadly be said to be the accumulated results of this process – the eating up of flexibility in response to stresses of one sort or another."[27]

We need to note that Bateson was working within and building upon an emerging body of cybernetic analysis. In particular, he was referring here to Ashby's Law, which states that two systems (such as human and non-human ecosystems) are:

> ... describable in terms of interlinked variables ... such that for any given variable there is an upper and a lower threshold of tolerance beyond which discomfort, pathology, and ultimately death must occur. Within these limits, the variable can move (and is moved) in order to achieve adaptation. When, under stress, a variable must take a value close to its upper or lower limit of tolerance, we shall say, borrowing a phrase from the youth culture, that the system is 'up tight' in respect to this variable, or lacks 'flexibility' in this respect. But, because the variables are interlinked, to be up tight in respect to one variable commonly means that other variables cannot be changed without pushing the up-tight variable. The loss of flexibility thus spreads through the system. In extreme cases, the system will only accept those changes which change the tolerance limits for the up-tight variable.[28]

Bateson then went on to note that:

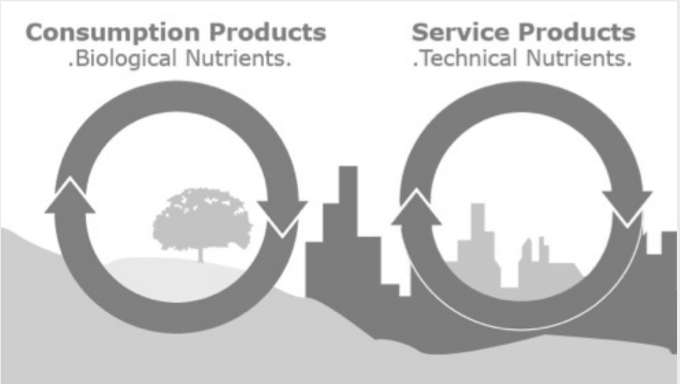
> ... if a given variable remains too long at some middle value, other variables will encroach upon its freedom, narrowing the tolerance limits until its freedom to move is zero or, more precisely, until any future movement can only be achieved at the price of disturbing the encroaching variables. [29]

An exploration of the ways that learning, teaching and adaptation occurs in organised systems therefore characterised Bateson's research (and indeed that of many of his colleagues). As has already been seen, a consideration of how to learn to empathise with ecological systems was a key theme of this work in terms of urban planning, and he continued by saying that:

> The healthy system, dreamed of above, may be compared to an acrobat on a high wire. To maintain the ongoing truth of his basic premise ('I am on the wire'), he must be free to move from one position of instability to another, i.e., certain variables such as the position of his arms and the rate of movement of his arms must have great flexibility, which he uses to maintain the stability of other more fundamental and general characteristics. If his arms are fixed or paralysed (isolated from communication), he must fall ...
>
> During the period when the acrobat is learning to move his arms in an appropriate way, it is necessary to have a safety net under him, i.e., precisely to give him the freedom to fall off the wire. Freedom and flexibility in regard to the most basic variables may be necessary during the process of learning and creating a new system by social change. These are parades of order and disorder – which the ecological analyst and planner must weigh.[30]

There remains today an enormous amount that can be learned from Bateson's notes on ecological planning. In the section that follows, I will therefore reflect upon some contemporary ecological systems design theory, and will consider what a critique based upon the insights of both urban political ecology, and Bateson's neo-cybernetic ecological aesthetics, might potentially look like.

Cradle 2 Cradle - Remaking the way we make things



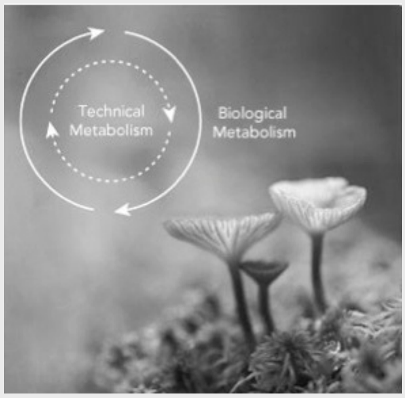


Fig. 8.10-1. Cradle to Cradle (c2c) is one of the more important contemporary whole systems design theories. It is both a critique of existing manufacturing models, and a new manufacturing paradigm. It was conceived by American architect William McDonough and German industrial chemist (and former leading Greenpeace activist) Michael Braungart. They audaciously proclaim c2c to be “the next industrial revolution.” Whereas many “sustainable” (a term they reject) design therories and economic models insist on the need to develop a zero growth economy, Braungart and McDonough insist that growth is possible – but only if on the basis of their metabolic system.

The basic principles are simple. According to c2c thinking, an analysis of natural ecological systems shows that “waste equals food”. Living systems are not, they argue, characterised by any human sense of efficiency. A fruit tree, they note by example, produces vast amounts of fruit that will never germinate, but will rather fall to the ground and rot. However, this is in no sense an ecological problem, as the waste from this system is up-cycled as food for other systems in its environment. Braungart and McDonough argue that all (literally all) human production needs to be re-conceived so that nothing ends up abandoned in landfill. The proposed industrial ecology models itself on the principles that it describes working in the natural environment, wherein the waste of one part of the ecosystem becomes food for another part.

In c2c thinking, everything needs to be a part of one of two metabolisms - the biological nutrient cycle and the technical nutrient cycle. To be a part of the biological nutrient cycle basically means that something is capable of being safely composted and returned to the ground, or otherwise used as food by another organism. To be part of the technical nutrient cycle means to be designed to be easily recycled (or better, up-cycled). Interestingly, what this actually means is two different kinds of economies emerge. The biological metabolism generates an economy based upon direct consumption, whether consumed by us as food or by microbes as compost. The technical nutrient cycle on the other hand generates an economy which is increasingly seen as largely not based upon consumer ownership at all, but is rather based upon service contracts.

Braungart has used the example of television to illustrate the shift. People want to watch television, they do not want to own what will increasingly be understood as a box of dangerous metals and chemicals. Whilst today it is still possible to throw away a television, in the near future the disposal of such items will inevitably become difficult and expensive. On the c2c model, it increasingly makes sense for these kinds of items to remain the responsibility of (and under the ownership of) the manufacturing organisations (whether privately or socially owned is not discussed), who lease them on service contracts but retain ownership of what for them is a box of valuable material resources. They design them to be easy to repair/recycle/up-cycle, and effectively use their customers as a storage site for fixed capital assets. Inevitably, it means a much closer and longer term relationship between producer and user, and the kinds of business models that emerge are quite different to mass producing cheap disposable goods. They potentially suggest mutual ownership and co-operative models shared by users, as well as more typically capitalist formations.

For many supporters of c2c principles, one of its biggest attractions is that, like natural ecosystems, the metabolisms that it proposes as a whole do not produce any waste. This means that growth and material abundance might become conceivable again, albeit on very a different basis to the consumer capitalism of today.

8.6 Contemporary Whole Systems Design approaches

In the decades since Bateson met with the New York planners, environmental issues have provoked, and provided the context for, a series of design responses – almost all of which are based upon systems theoretic concepts in some way. There is much to be commended in many of these approaches, and I have cited examples such as McDonough and Braungart's *Cradle 2 Cradle* and Ezio Manzini's *Sustainable Everyday*, not least because of what I consider to be their importance and usefulness today. These systems design approaches have interesting contributions to make to thinking about architecture, design and urban and regional planning, based upon attempts to articulate and practice a renewed relation to nature. However, all of these systems based theories, I argue, still need significant and ongoing amendment.

Not only are the systems disciplines deeply entwined within all of ecological theory, but systems approaches lie at the heart of almost all important approaches to "sustainability" in design thinking today. These approaches can all too easily become new attempts to achieve control and domination over nature, and/or equally, over humans, when they are unfolded within a capitalist framework. To find ways to incorporate an awareness of these issues within systems design, I propose that we have to subject these systems approaches to a double critique, based upon radical cybernetics and urban political ecology. The former suggests that any attempt to explore and implement sustainable systems design must be conceived as an attempt to practice an open-ended and "experimental approach to design as a process of revealing rather than enframing."[31] The latter critique insists that we must work through "political projects that are radically democratic in terms of the organisation of the processes through which the environment that we (humans and non-humans) inhabit become produced."

This dual critique is, I would suggest, key to re-imagining the project of urban planning today. It is also the basis for evaluating existing design activist and systems design initiatives – i.e. do they facilitate, and are they open to, real democratic systemic change? Do they suggest a new conception of nature and culture? Do they promote a democratic engagement with and ownership of the production of the environment, or are

Multi-local networks

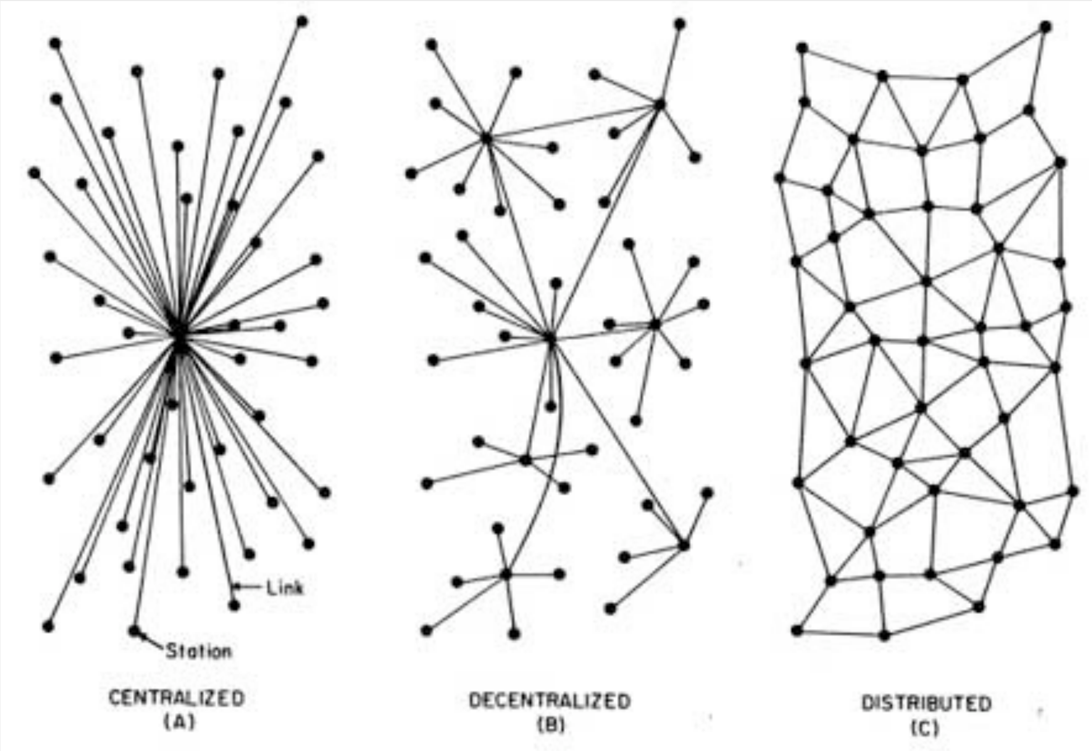


Fig. 8.12 Diagram showing different network structures.

The relationship between the local and the global comes up in almost all discussion around sustainability, whether concerning energy use, food production, money, or politics. Feudal economic formations were primarily based around disconnected localities and centralised power structures emerging (a). Capitalism developed a global market, but one which was a series of linked centralised structures (such as the nation, and the corporation), similar to (b) below. Globalisation has been generally experienced as a destruction of the local, with centralised global networks dominating disconnected localities. It is widely argued that the most advanced elements of capitalism (such as the internet, or global capital flows) are increasingly organised themselves on distributed network models (c). Just as capitalism is increasingly organising itself upon distributed network models, so too are many anti-capitalist networks (as famously theorised by Michael Hardt and Antoni Negri).

Design theorist Ezio Manzini has argued that IT communications technologies are increasingly facilitating a re-valorisation of the local, but as a connected local, as a distributed network. He more broadly argues that designers need to conceive of multi-local global distributed network systems. As an organisational form, this kind of network structure is by far the most robust.

In terms of our own future scenarios, distributed local-global networks offer the most robust and progressive models as they are organisational forms that devolve power, and they could work across a range of future scenarios from new forms of democratic ecosocialism, to continuing capitalist development, to total breakdown. Equally, if large sections of the planet are to become vulnerable to climate events or political instability, then the large scale centralised organisational forms that currently dominate our food, energy and political structures will become very problematic. With many of our current organisations and infrastructures, if the centre is taken out, the periphery dies. With distributed network structures, large sections of the net can be removed, but the localities can still survive and communicate. It is for these reasons that environmental thinking is on the whole supporting the development of globally linked but locally based democratic organic food and renewable energy networks.

they actually only providing greater access for capital to further commodify and privatise public space?

If systems theory responses underly, with varying degrees of consciousness, almost all ecological design approaches, it is just as true that related systems concepts are informing and arising within the broader green left discourse. In particular there has been a return to various anarchist theory informed conceptions of self-organisation. As with Manzini's more directly design activist work, concepts of self-organisation within non-hierarchical networks have been thus revisited and revitalised through the use of digital social media technologies. As David Harvey observed at the World Social Forum in 2010:

> Contemporary attempts to revive the communist hypothesis typically abjure state control and look to other forms of collective social organisation to displace market forces and capital accumulation as the basis for organising production and distribution. Horizontally networked as opposed to hierarchically commanded systems of co-ordination between autonomously organised and self-governing collectives of producers and consumers are envisaged as lying at the core of a new form of communism. Contemporary technologies of communication make such a system seem feasible. All manner of small-scale experiments around the world can be found in which such economic and political forms are being constructed. In this there is a convergence of some sort between the Marxist and anarchist traditions that harks back to the broadly collaborative situation between them in the 1860s in Europe.[32]

8.7 Architecture and the Production of Concepts

Throughout this thesis I have been trying to think about architecture as a producer of concepts which are both experiential and cognitive. Architecture can be used to stage a speculation upon the nature of order. It offers a distinctly aesthetic mode of thinking about systems and the relations between processes, and as a discipline and profession – in its modern form at least – has a curiosity and need to consider a wide range of systems, whether ecological, urban, social, financial, phenomenological. Such embedded or situated concept formation extends ideas about the individual and the social, the body, and the mind, in time and in space. As noted, I am not here restricting architectural knowledge to the production of buildings. Indeed, in the contemporary period, new

buildings *per se* are probably one of the less interesting avenues and applications of architectural research. Certainly many of the theoretical studies referred to in this thesis do not necessarily have immediate tectonic implications. I am rather making a claim for an architectural contribution to contemporary debates concerning “ecological thought”, and the attendant attempts to redefine nature, matter, mind, self, agency etc.

Architecture, as I am trying to define it, is an extended domain that spans the individual performing body and our collective social forms. It both mediates and conceptualises metabolic flows of matter, energy and communications that are, in the words of David Harvey, “*wholly natural*, and *wholly social*, at the same time.”[33] The idea of architecture here is a technological and social prosthesis – *an organ* – that extends the human subject in time and space. It is also a sensitivity to the multifarious ways that the human organism is always already, both naturally and culturally, ecologically extended. In the previous chapters, a conception of the human emerges which is quite distinct from the models that characterised classical humanist discourse. The human is not really in any simple way the clearly bounded object that can be seen as distinct from and opposed to the rest of the world, but is always, in an important sense, a highly plastic and adaptive assemblage of biological, social, energetic, material and environmental systems. In this sense, it is not simply the fact that today we are witnessing the emergence of what has been described as a planetary post-human cyborg condition, but rather that this condition has always been the case – albeit though in very specific and different socio-cultural and ecological forms at various points in history.

Within such a formulation, architecture can and does play a distinct role. We might say indeed that the *architectural event* mediates some kind of abstract yet practical conception concerning an extended human-natural environment. The architectural proposition is here that which *stages* and brings into the *domain of experience*, these individual, social and political and natural and cultural ecological events.

Ultimately, this thesis suggests that critical urban ecology – the architectural investigation of ecological aesthetics and urban political ecology – will be a key field of both theoretical and practical investigation in the coming years, as the deep contradictions of capitalism unfold at an intensified global scale, potentially destroying entire swathes of the planet’s social and ecological fabric.

Critical urban ecology will take the form of both abstract theory and the articulation of concrete political demands. It must include both autonomous formal research into both an abstract and an experiential language of process, organism and ecology, but also real design and policy intervention. It must facilitate and inform both top down global planning, and bottom up and distributed local activism. I therefore conclude that there is indeed scope for a critical enclave of architectural knowledge and practice, one that might resist the demands of global capitalism, and turn its energies to the benefit of our social and ecological systems.

Appendices

Appendix 1: Design Research – Video Feedback as Rhythmanalysis

Fig. A.1 Initial video feedback studies produced by Alexis Kyrakides.

"What we live are rhythms – rhythms experienced subjectively. Which means that, here at least, 'lived' and 'conceived' are close: the laws of nature and the laws governing our bodies tend to overlap with each other – as perhaps too with the laws of so called social reality."
Henri Lefebvre, *The Production of Space* (Oxford: Blackwell, 1991) p.206.

During the first two years of my teaching on the Graduate Diploma in Architecture at the University of Westminster, I was particularly interested in exploring the question of “interface” in architecture (which I later explore further, organising the “Spatial Interface” conference at the University of Westminster in 2005). I set a series of project briefs under the title ‘Dancing with the Machines’, which asked students to work with machines and media as design tools, as design contexts, or as extensions to a human-machine cyborg which needs to be designed for. Here I was particularly interested in exploring how empathy theory might facilitate an exploration of the way that the human body interfaces with technology, media and tools in space – empathy being one of the feedback loops of architectural experience.

Often the studio was interested in creating interactive systems which were capable of generating images as part of the system. These included experiments by several students over a few years which involved setting up ecologies of digital video camcorders and monitors, as in the early studies of Alexis Kyrakides and in the installations of Alkiviades Sakellarides. In both of these cases the students worked within the spaces produced by video feedback. This is a simple cybernetic system which can be described by the diagrams below.

The video camcorder is set up to feed into a monitor, such that the monitor is displaying live the video produced by the camcorder. If the camcorder is set up so that the lens is facing the monitor, i.e. recording its own image, then a basic positive feedback loop is created. It is positive loop, in that any signal which is introduced into the system becomes amplified, as it spins around the loop at speeds determined by the frequency of the monitor refresh rate, the video software and the circuitry. Typically, the signals introduced became the moment of interface with an emergent “organism” or “mind”, and included:

- an object such as a moving hand inserted into the space between the camera lens and the monitor
- the movement on the screen being filmed of a mouse cursor or other screen-based signal
- noise created via dust or imperfections in the lens, monitor, or circuitry,

In addition to the primary positive feedback loop, there were also in most cases at least some negative feedback loops as well. For example, there are inbuilt limits set on the circuitry of most monitor, which stops the signal endlessly amplifying until the monitor tubes burn out.

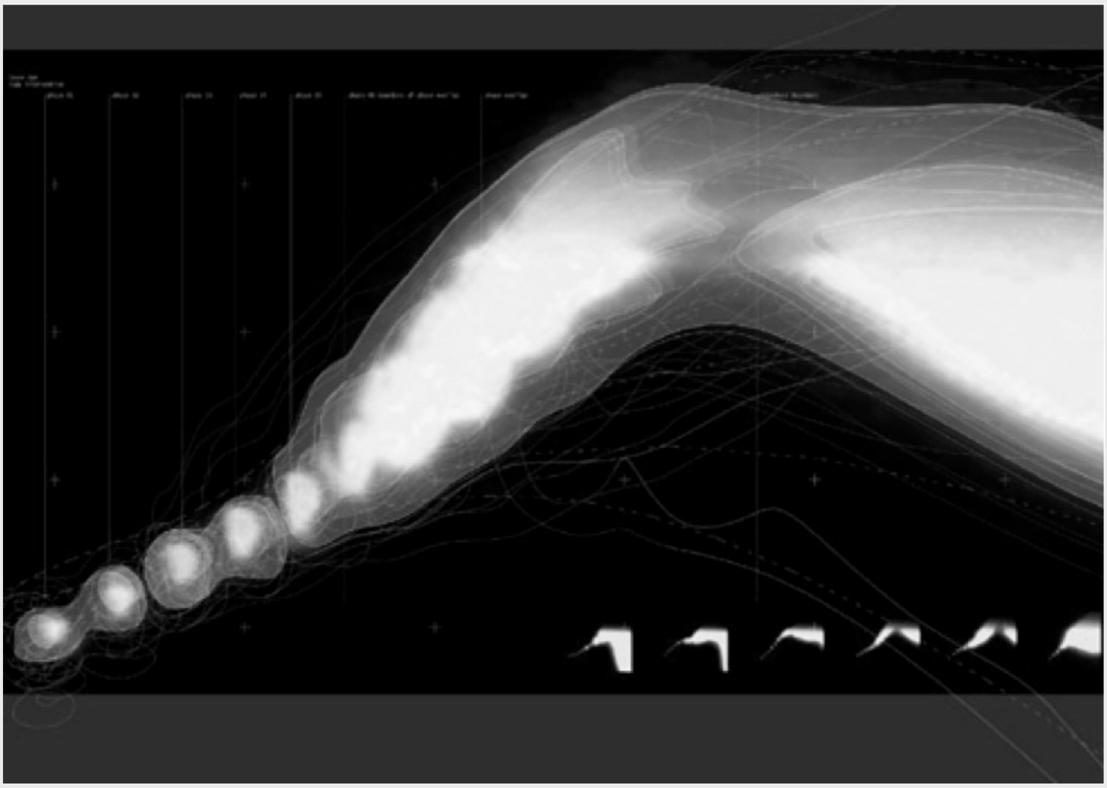


Fig A.2 Video feedback images produced by Alexis Kyrakides

The first student to engage seriously with this work was Alexis Kyrakides. He extended his experience of video feedback experiments into a proposal for a cybernetic landscape, called the “Kinematic Garden,” proposed next to the Thames Barrier and near to City Airport, in London. The scheme won the RIBA Silver Medal 2001, the Serjant Prize and the SOM Prize. Cedric Price described the scheme as “a mushroom of delight!” The text that written to describe the scheme read:

> The Kinematic Garden is a spatial experience that introduces concepts of the continually evolving system as architecture, and relates ideas of process, temporality, cause and effect, and self-propagation states and events. Through interaction, the future course of the system is modified. Time becomes an elastic concept – the event destabilised. Evolutionary structures become revealed through time and form. The Kinematic Garden is not a fixed design, it is a language of parts that may be prescribed to any site, to invigorate it and to reveal the vibrancy of its urban fabric, as a series of events and experiences.
>
> Through a series of vastly interconnected “dumb” devices – dumb in that there is no programming, no digital system, just a simple analogue stimulus response to immediate surrounds, a manmade synapse – emergent structures of event and experiences develop and cascade around the very fabric of the site as light, vibration, and sound. It is this very notion that dictates one of the fundamental premises of the kinematic garden, that emergent properties exist within the framework of simple interactions. The site is alive – in the system is trapped the very life of the city and its users as a perpetual feedback loop of cause and effect. The site has “miked up” the city.
>
> The site is alive with an ambient resonance of events within the urban fabric, feeding off the events that surround it. Incoming planes landing can be felt through the kinematic grass, the operation of the Thames barrier reverberates through the site. A person waving their hand may set off as a wavefront that would allow someone to feel it some distance and time away. The site is alive, a non-linear system that is a real nature.

Fig A.3 Video feedback images produced by Alexis Kyrakides

The scheme continually feeds-back on itself, responding to changes in light, sound, and media patterns. Its liquid form pulses and evolves in response to its environment and its users, whose presence and movement forms an integral part of the kinematic experience. Users may learn to drive the machine, to seek brief periods of control within its constant state of non-linear, emergent flux - an electro-analogue prosthesis.

Grown out of the performative spaces of video feedback, this is architecture as a membrane: a kinaesthetic interface to the global city. Dancing with the machines, between the rhythms of the body and the rhythms of the airport, this kinematic garden is a landscape that you can learn to drive.

Fig A.4-5. Scenes from the Kinematic Garden

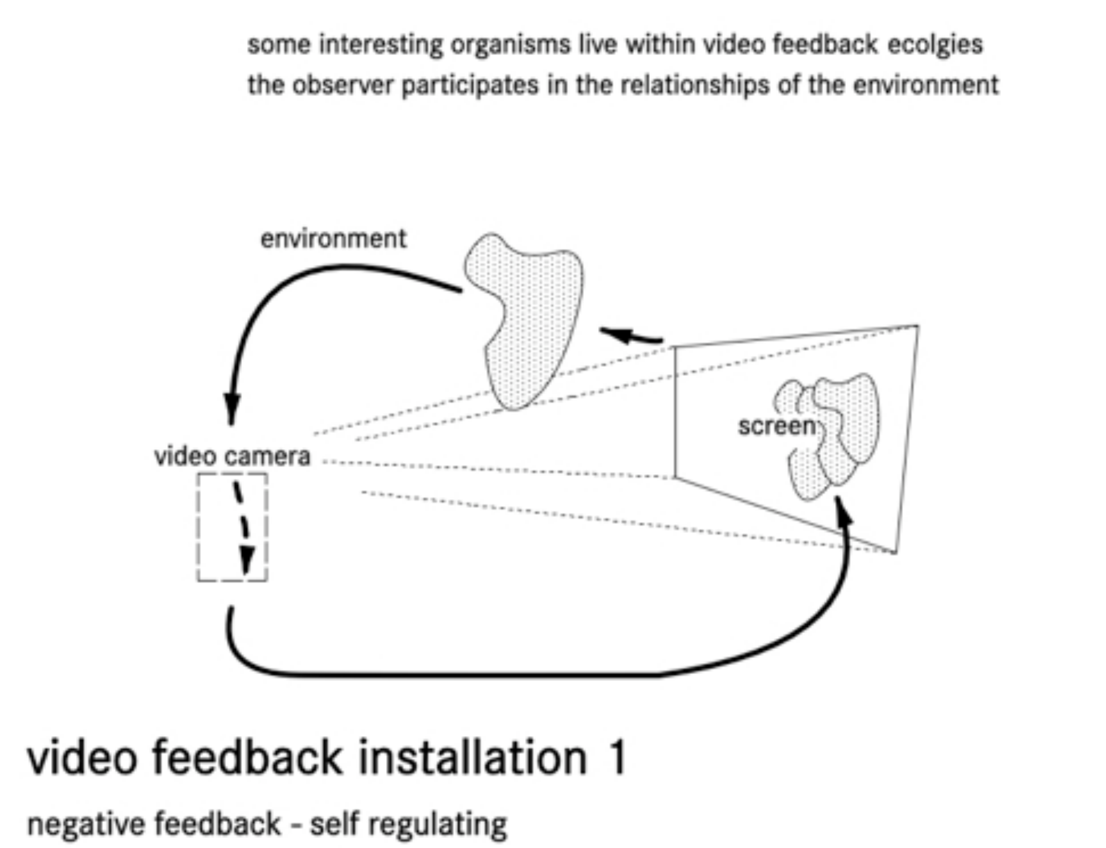


Fig A.6 Cybernetic diagram of basic video feedback setup

In general, there was a combination of negative and positive feedback loops in these systems. One of the principles of cybernetics states that whenever there is a odd number of negative loop segments, the system will be self-regulating, and able to reach equilibrium states – or indeed, maintain itself at a steady state far from equilibrium.

Experiments with these systems can be fascinating, as there are some strange emergent organisms that come to life within these ecologies. The experiments included exploring how to play, how to drive and work in the space between the camera and the monitor, and the world that is “brought forth” – in the sense of Maturana and Varela – on the monitor display. These experiments also proved to be an excellent pedagogic method for exploring questions around kinaesthetics, body movement in space, emergent form and pattern, analogue and digital, and spatial interface.

Stroking the space between the camera and screen in order to bring an organism to life, and the experience that one’s cognitive map was growing to incorporate the space on the screen and that one was learning how to drive the environment, enacted the same kind of technological study of empathy that Lars Spuybroek was working with when discussion projects like the NOX Water Pavilion (see Fig. 5.xx for a further discussion.) The experiments provided excellent constructs for a reflecting upon a number of concepts from Henri Lefebvre. The experience of engaging with these assemblages of cameras, monitors and mirrors seemed to speak directly to an aspect of rhythmanalysis: they could be theorised as interface environments where the mix of image and performative space dialectically enacted the terms spatial practice, spatial representation and representations of space. It is also of course very useful to consider this exercise as a study in internal relations and relational spacetime.

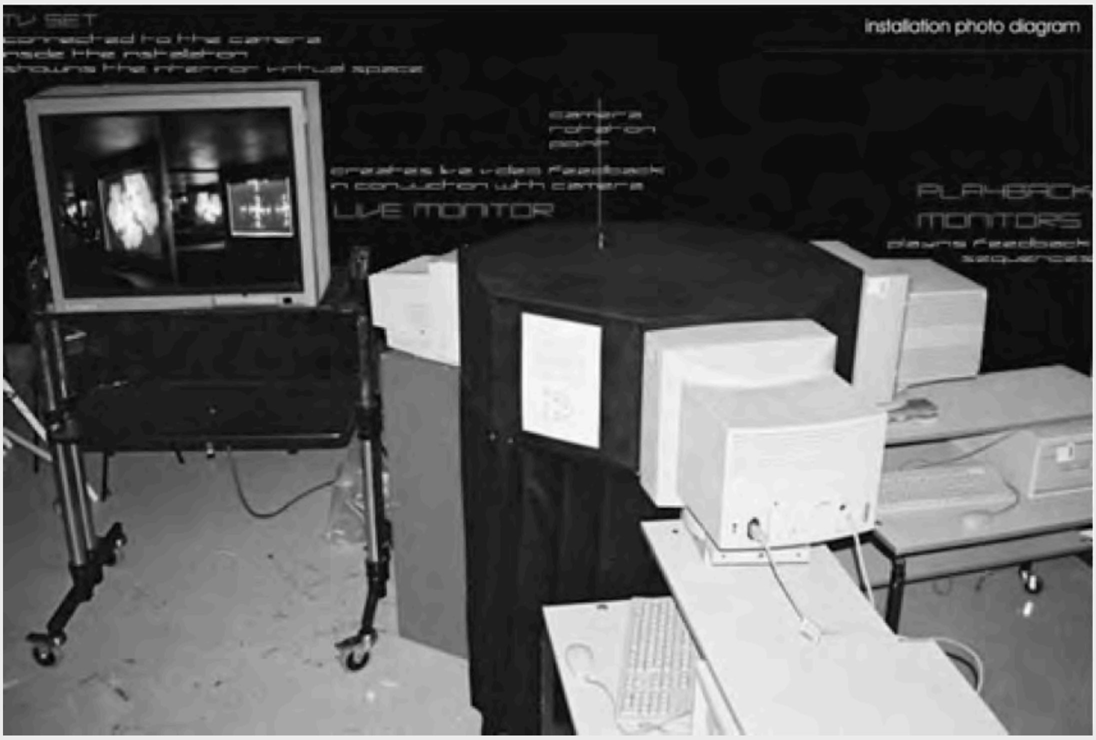


Fig A.7. Alkiviades Sakellarides extended video feedback installation

Alexis Kyrakides described one of the aims of the studio: “If we are to push the idealised goal of creating intelligent buildings that behave as complex systems rather than fixed, deadweight buildings, then we must be sure that as architects we more fully understand the principles of complexity, emergence, and non-linear systems, that events in space and time have, within the seeming chaos, an elegant, hidden order that possesses it own beauty, but also a level of efficiency that dwarfs the simple attempts of man to control his environment with such linear thinking.”

The year after Alexis won the RIBA Silver Medal for the Kinematic Garden scheme, Alkiviades Sakellarides also explored video feedback, this time constructing a more ambitious assemblage of multiple monitors and mirrors, in an enclosed environment, but with an additional TV external output.

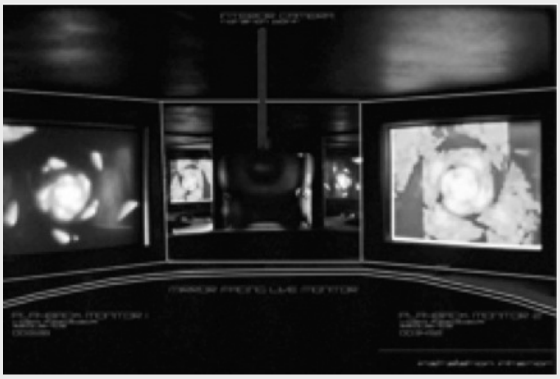


Fig A.8-9 images of the interior of video feedback installation. Constructed and photographed by Alkiviades Sakellarides

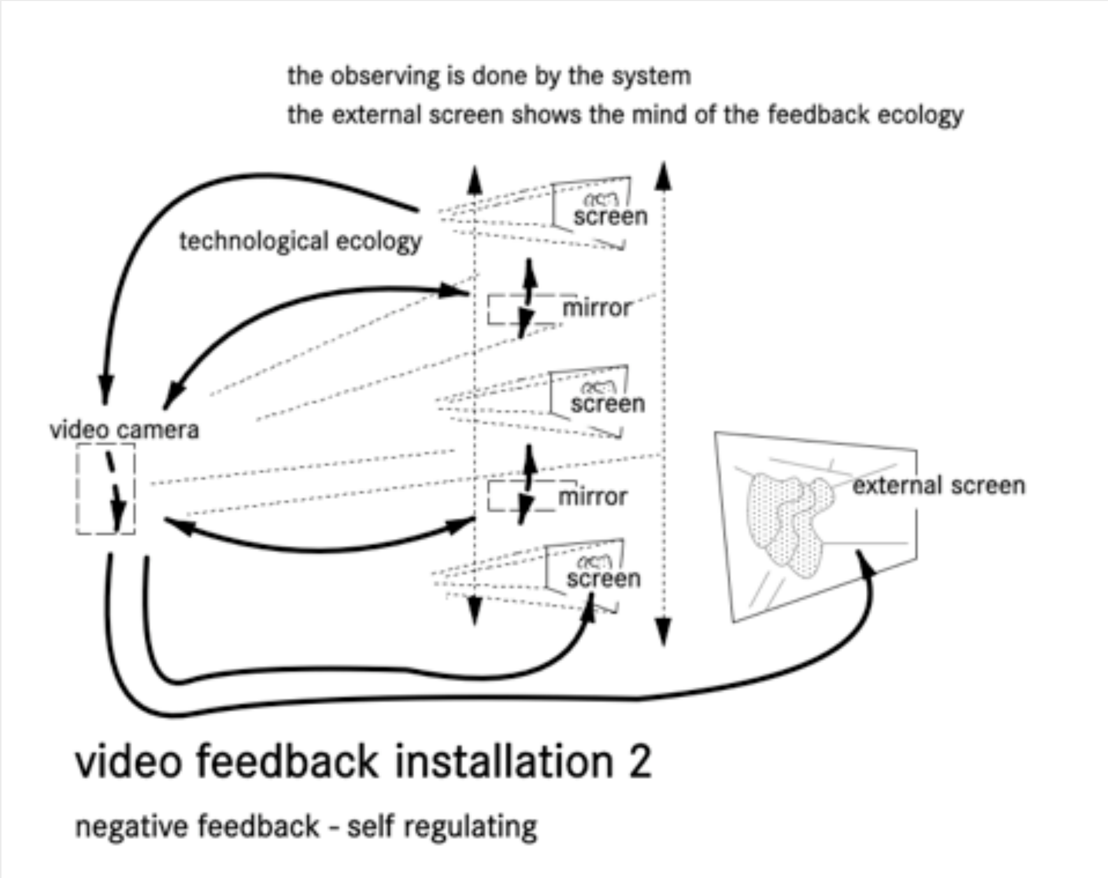
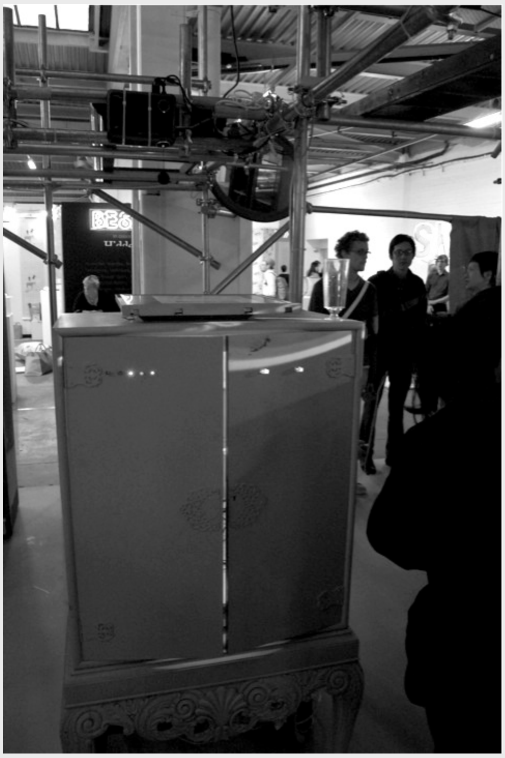
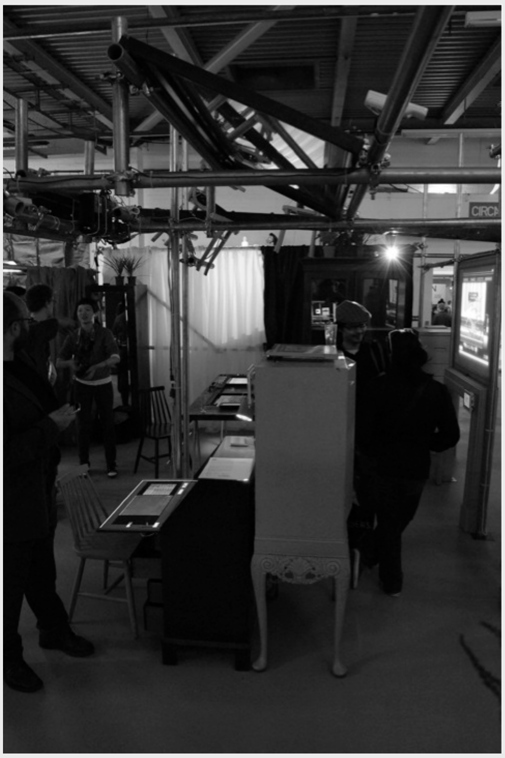


Fig A.10 A cybernetic ecology diagram showing the feedback loops of the installation by Alkiviades Sakellarides.

I find these student experiments very useful to look back on now. They are both very clear examples of the construction of cybernetic ecologies, in that they clearly construct a scenario in which the participatory role of the observer is concretely expressed and visible in the system. Interestingly, these kinds of video feedback ecologies are referred to by Douglas Hofstadter as examples of primitive strange loops. For Hofstadter, strange loops are examples of systems which have the ability to pick up on and internally represent patterns in their external environment, and also to recognise and replicate patterns within their own structures. Strange loops are patterns, but patterns which are themselves pattern recognition and replicating tools. For Hofstadter, strange loops are not just minds (normally patterns in this sense are minds), but are actually the foundations of self-consciousness. He states “a mere pattern called ‘I’ can shove around inanimate particles in the brain no less than inanimate particles in the brain can shove around patterns. ..an ‘I’ comes about.. via a kind of vortex whereby patterns in a brain mirror the brain’s mirroring of the world, and eventually mirror themselves, whereupon the vortex of ‘I’ becomes a real causal entity. For an imperfect but vivid concrete analogue to this curious abstract phenomena, think of what happens when a TV camera is pointed at a TV screen so as to display the screen itself.. what I call ‘self-engulfing television’... or a ‘level crossing feedback loop.’” (Douglas Hofstadter, Gödel, Escher, Bach - An Eternal Golden Braid (London: Penguin, 2000) p.xxiv). Interestingly, although we did not realise it at the time, Hofstadter had described a possible installation which could achieve more fully what he describes as “self-engulfing television”. It involved mirrors and sounds very much like the installation by Alkiviades Sakellarides.

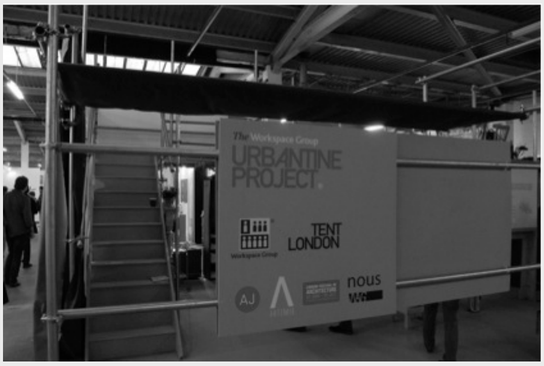
Appendix 2: Design Research – The Extended Mind of Open Tables: Socio-Spatial Interaction





Figs. A.11-21. Open Tables Installation in Truman Brewery, Sept 2008. Open Tables is an ongoing research project – a software application and a spatial environment – which researches and facilitates collaborative working between individuals and groups. The first prototype of Open Tables was launched as a website at the Nous Gallery, London in September 2008, and the main installation was installed at the Tent London 2008 design show, in the Truman Brewery on Brick Lane, later in that month. Designed and built by WAG Architecture, with a team of collaborating engineers and hackers, OT was perhaps the world’s first website to have a physical front end. The aggregator software that we produced for Open Tables has since been adapted and deployed in the Open Studios project for the Department of Architecture at the University of Westminster.

Open Tables was conceived to be an immersive information ecology, that facilitated in particular co-design activities. It brings together contemporary thinking from a number of diverse practices and intellectual disciplines: innovation management, mind-mapping, workplace design, network theory, interaction design and cognitive science. Specifically, Open Tables is an application and study in Extended Mind thinking. Our minds are not in any simple way confined to our physical brains, but are broadly dispersed out into the environment. We thus use our external environments as cognitive spaces: in a real sense, cognitive processes which start in the brain are extended out into the world, through tools, language, social practices and so on. We empathise with these environments and the information that they contain. Open Tables creates the conditions for collaborators to share their Extended Minds. It is, in Roy Ascott’s definition, a telematic environment.



The project originated in a brainstorming workshop that I led as part of a Holistic Design short course at Schumacher College in February 2008, where the group explored the question of whether it might be possible to develop a design context, platform or environment that would work as an open-source design environment. The central concept that emerged in this workshop was the idea of an ‘open table’ environment which at this time the group imagined might be primarily web-based, but which might also take on real physical form. We imagined this might be a transitory presence in, for example, cafes or similar spaces. The proposition was to create a virtual and sometimes real ‘creative commons’ space or network, where designers might share ideas, take problems to be solved etc, in an open source way. It was imagined that it might facilitate LETS-type financial transactions, if necessary, and that external clients might also post needs to be solved, etc.

A number of ideas taken were from this workshop as the start of a competition entry at WAG Architecture a few months later, where we collaborated online with two members of the original design team during the competition process. WAG won the Tent Urbantine “Fast Architecture” competition, and those individuals then came to London to join us for the installation and operation of the project. The core competition team was myself, Filip Visnjic and Wei Lee from WAG, with ex-Schumacher students Fabio Barone and Amalia Lauer. The design development and installation construction team was as above, but also including Cordula Weisser and Antonio Passaro from WAG, with consultants Alexander Kohlhofer (interaction design), Thomas R. Koll (software engineer) and Marco Quaggiotto (information design), all co-ordinated by Filip Visnjic.

The Tent Urbantine “Fast Architecture” competition had been sponsored by the Workspace Group PLC, a company that rents out office and studio space – largely to small and often creative industries companies. The competition brief asked for explorations concerning future developments in workplace environments. Our proposal took on some of the original Open Tables ideas concerning collaborative working, and explored in what ways a spatial environment could facilitate collaborative working – in particular drawing upon recent developments in what has become known as pervasive or ubiquitous computing. This was defined by the legendary PARC Xerox visionary, Mark Weiser, as “the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives.”

I was particularly interested in drawing upon experiences that I had had – both good and bad – contributing to creative "brainstorming" workshops or sandpits for companies such as WHSmith, BP, Procter and Gamble, and Trusthouse Forte. Typically, these exercises were based upon fast-moving collaborative exercises, often led by brand development and management consultants, producing what were often referred to as "group minds" (essentially walls and tables covered in Post-It notes). These sessions were notable for me in that, when successful, they have been some of the most distinctly trans-disciplinary experiences, bringing together wide mixes of professions and skill sets. Indeed, this serves to remind one that capital is also inherently trans-disciplinary, and one important reason trans-disciplinary work in academia is needed is simply to stand any chance of *seeing* the world as it is!

The core purpose of the Open Tables research project was to explore the potential for new kinds of collaborative working to emerge in spaces that combine analogue and digital modes of interaction: engaging both the mind in its various forms, through a more physically and socially immersive engagement with the senses, in the navigation and production of information.

What does this project mean, then, as design research? Well, typically when using computers, and accessing networks of information on the internet, we occupy a somewhat autistic condition – a lonely and strictly individual engagement with a computer monitor and keyboard. In this installation, however, we explored how the interface and interaction with networks might be expanded to a more social condition. A typical meeting room in an office has a table to sit around, and probably a flip chart and projector. More creative organisations often realise the importance of providing a variety of stimuli and environments, and typically have some break-out, lounge-like spaces. Open Tables combined these two familiar conditions, and intensified them by introducing web-based information flows and social networking scenarios, in this instance using interfaces which are based upon digital projections, displays and interactions, incorporated into familiar objects, provoking physical interactions with data, often social, using the whole body, rather than just a mouse and keyboard. As Malcolm McCullough has observed, "interface design has become interaction design, and interaction design has come into alliance with architecture", requiring the development of "a theory of place for interaction design" (Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing and Environmental Knowing*, MIT, Cambridge MA (2005) pp. xiv-xv)

Open Tables worked by collecting (or more accurately in software terms, aggregating) from the web: text and images from RSS based web sites, as well as Flickr and YouTube content, according to various keyword searches or news feeds. For the Tent Urbantine installation, we had defined four research topic areas, looking at (somewhat self-reflexively) contemporary design issues around sustainability, workplace environments, and ubiquitous computing. However, Open Tables can of course be set up to research any topic depending upon the needs and interests of the client/participant/co-designer – from bike design to stock markets. Indeed, the aggregator application behind the University of Westminster Open Studios project collects feeds from each studio and research group blog in exactly this way.

Within the OT installation the webapp content was engaged with via XML outputs through a series of physical spatial interfaces. Three interactive tables were constructed out of hybrid assemblages of recycled antique furniture, Max MSP software and hacked Nintendo Wiimotes (which provided a means of producing spatial infrared based interactions). The interfaces were designed to be big enough to be used by more than one person, and indeed perhaps even difficult to use by just one person.

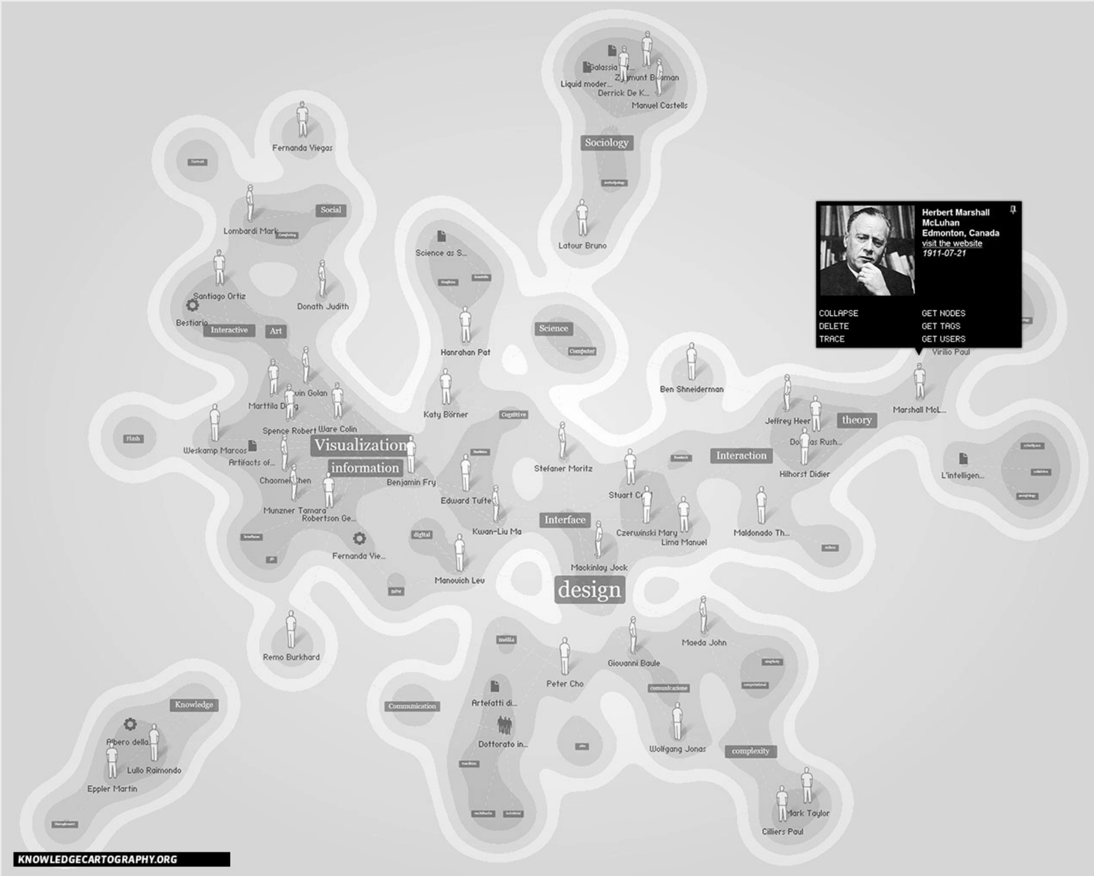


Fig. A.22 Marco Quaggiotto, Knowledge Landscapes (2008), an interactive database or network visual interface, which visualises interconnections between information. Marco is a software designer, and was a service systems design masters student of Ezio Manzini at Milan Polytechnic. We first met at Manzini's "Changing the Change" sustainable design conference in July 2008 in Turin, and he collaborated on aspects of the Open Tables development, and adapted the knowledge landscape software to work as one of the wall interactives for the Open Tables installation.

In addition to the social tables there were other interactive wall stations. The wall elements were in general concerned with giving an overview of the data-ecology as a whole. One presents selected content in a digital Post-It note format, which allows the content to be clustered, mind-mapped and organised as required. On other walls the collected content is presented as "knowledge landscapes" – an showing relationships between for example different content items and their tags. In addition to working at the interactive stations, participants can contribute by sending sms text messages and photos from mobiles, or just by engaging with the main Open Tables website using standard computers.

The installation was constructed out of objects bought at various scrapyards and flea markets in east London, and created a surreal, Benjaminian feel. The scaffolding framework was suggestive of a lost piece of Constant's *New Babylon* project, or any one of the utopian network projects of modernism. We generally attempted to define a hybrid aesthetic of adjustability, hackerism, etc, – in both the software and the hardware – which would stand in stark contrast to the slick but untouchable aesthetics of typical consumer interfaces, and indeed the increasingly polished surfaces architectural construction.

The interfaces worked with familiar physical interactions, and familiar computer desktop interfaces, and as such de-familiarised both. The drawers of the Victorian writing desk were wired up to open folders on the application, for example. In general, this combination of informational technologies and familiar domestic objects and spaces suggested a broader potential for creating new collective meanings, exploring, as McCullough has suggested, a contemporary condition: "whereas previous paradigms of cyberspace threatened to dematerialise architecture, pervasive computing invites a defence of architecture.... interaction design must now serve our basic human need for getting into place" (p. xiv).

A.23.. High level view down into Open Tables Installation in Truman Brewery, Sept 2008
Caroline Jones has suggested that there are today six strategies through which contemporary artists can work to establish relations with technology. These are:

1. immersive: the cave paradigm: virtual helmets, etc
2. alienated: taking technology and making it strange
3. interrogative: repurpose or remake devices to enhance aspects, or, translating data into sensible systems
4. residual: working with an old technology
5. resistant: work that refuses to use marketed technologies for their stated purpose
6. adaptive: creative extension of tech, producing new subjects

In fact, to different degrees the Open Tables project manifested each of these modes of engagement with technology, although we did not set out specifically with that intention. See 'The Mediated Sensorium' in Caroline A. Jones (ed.), *Sensorium: Embodied Experience, Technology and Contemporary Art* (Cambridge, MA: MIT List Visual Arts Centre, 2006).

Fig. A.24. We first developed a mock-up of the installation, and constructed the various interactives, in a railway arch in Hackney Central, donated by a sponsor and former client and supplier (Artemis Stones).
Fig. A.25. Convincing the directors of the main sponsor of the exhibition – Tent London and Workplace Group PLC – that they were not just giving their money to lunatics. Filip Visnjic is on left, and Antonio Passaro is middle rear.

Appendix 3: Design Research – Athens Tower of Winds

This competition design for a mobile fabric evaporative cooling tower in Athens was based upon an urban ecology approach. The design was developed in 2003 at WAG as a competition entry for “Ephemeral Structures in Athens”, prior to the Athens’ hosting of the 2004 Olympics. Our final design was developed with structural engineer Aran Chadwick of Atelier One, and environmental engineer Professor Brian Ford, who was at WSP Environmental (now head of Nottingham School of Architecture.) The WAG competition team was myself and Cordula Weisser, and in the early stages Torsten Lange.

The brief asked for structures which might host temporary urban events (concerts etc) in Athens at the time of the Olympics, and widely used terms like ephemeral and parasitic in the brief. From the start we wanted to explore what an ephemeral and parasitic architecture might be, outside of the usual formal clichés (enjoyable as they might be on occasion). Our approach was based upon an analysis of the Athens urban ecology, which made clear that during the summer, the most socially valuable and usable urban space was composed out of shade and cool air. It seemed that any proposal needed to work with this primary condition of the site. We conceived of the architecture of the scheme as the production of environmental conditions, rather than any actual structures. We also wanted if possible to produce a scheme which might leave a legacy to the city after the Olympics. We started with studies which explored shadow creating devices, where an ‘ephemeral’ architecture of shadow might ‘parasitically’ move across existing buildings and urban spaces, defining a transient social space.

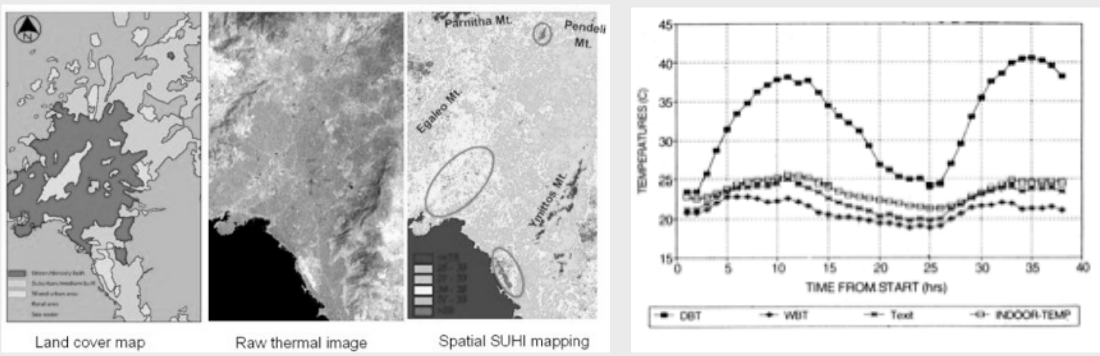
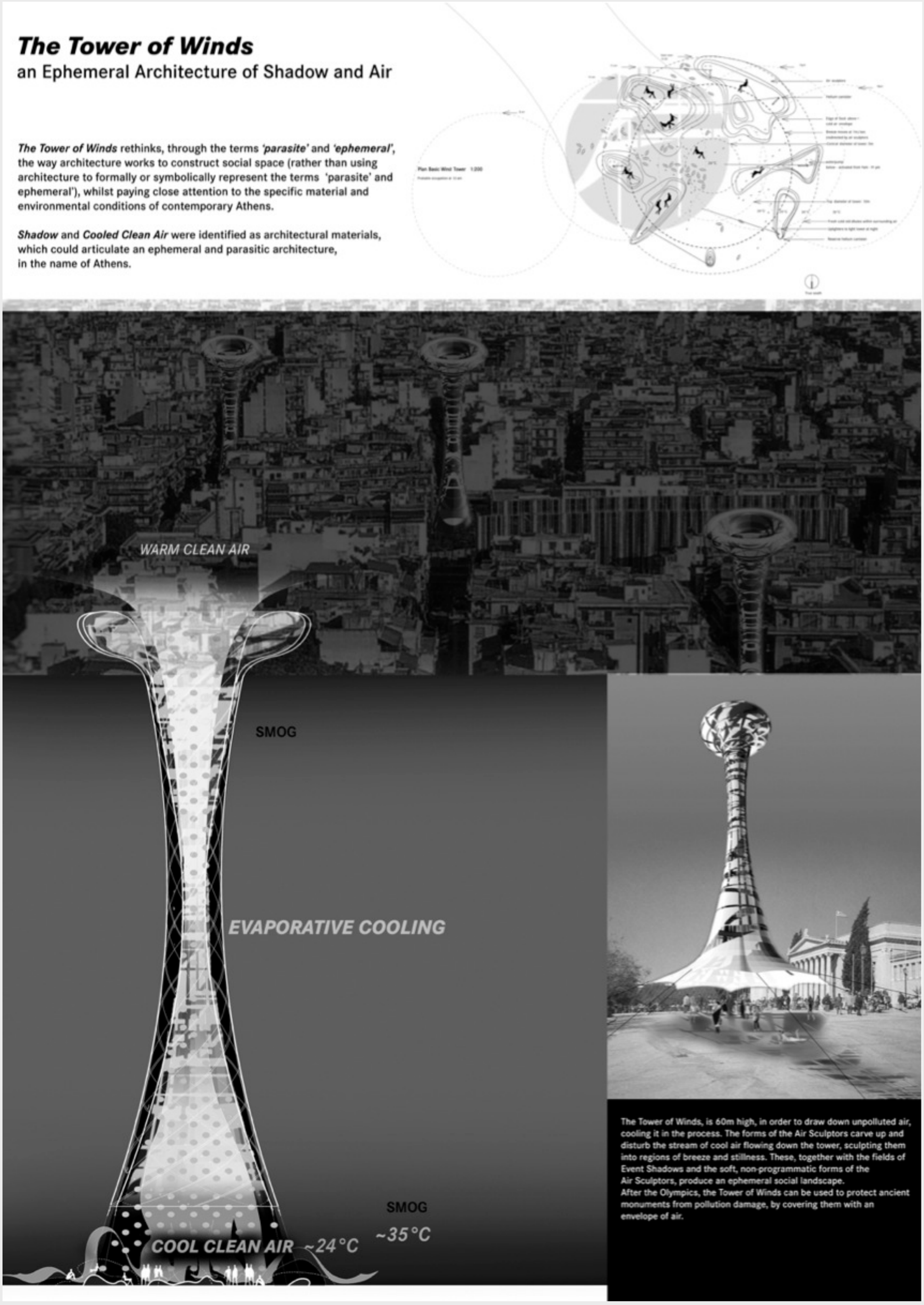


Fig A.26-7. Diagrams charting temperature and pollution levels in Athens, and thermal imaging maps showing Heat Island effect in Athens (See Santamouris, N. Papanikolaou, I. Koronaki, I. Tselepidaki and D.N. Assimakopoulos, “THE ATHENS URBAN CLIMATE EXPERIMENT - TEMPERATURE DISTRIBUTION” - part of the POLIS research project. Also see Oke T.R. : 'The Distance between canopy and boundary layer urban heat island'. Atmosphere, vol. 14, no. 4, p.p. 268-277, 1976)

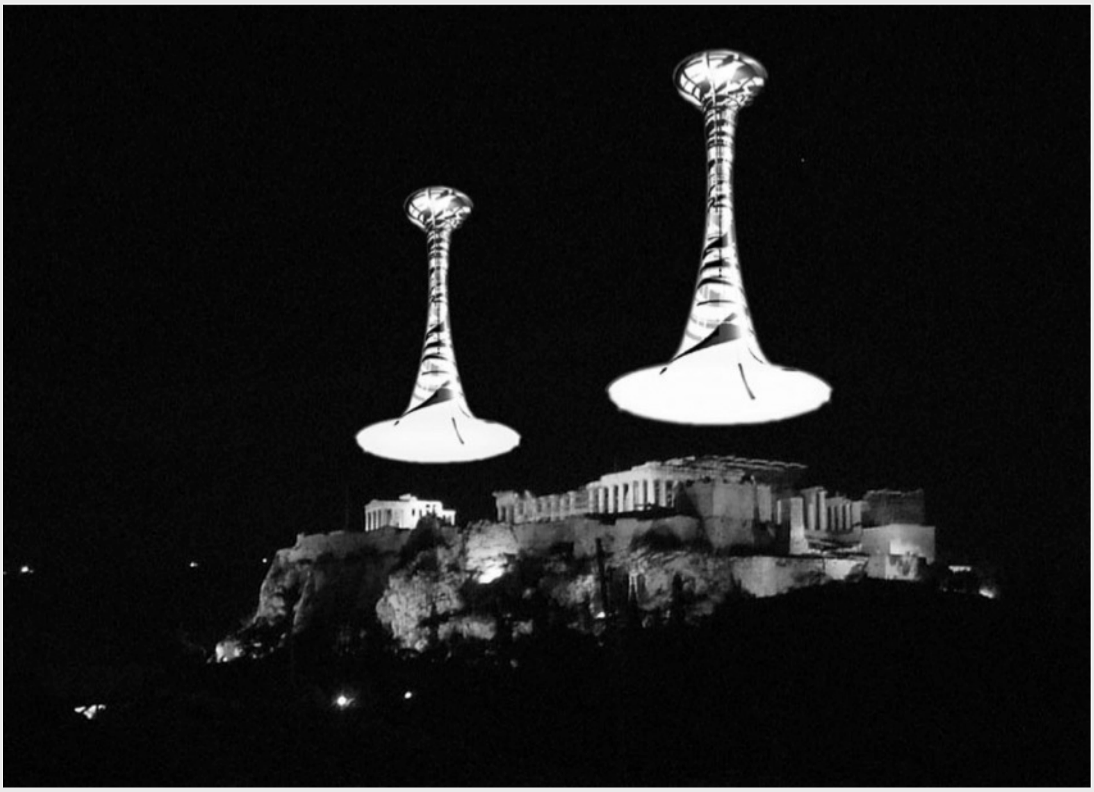
A more detailed study of the urban ecology revealed that Athens has a very particular local environmental condition, known as a “heat island” effect. The city has an average summer temperature of 37 degrees Celsius. It suffers from extreme pollution, primarily composed of heavy particles near ground level produced by car emissions. Because the city is surrounded by mountains on three sides, and is relatively sheltered from winds, this pollution builds up to levels which are bad for public health. In addition, because of the high levels of UV light, many of the pollutants acts as a corrosive catalyst which damages the fabric of historic buildings. However, the pollutant particles are heavy, and are concentrated in the first 40 m above ground level. The pollutants and buildings can be understood in eco-cybernetic terms, as a positive feedback loop - that is to say, amplifying the signal of the sun.

In this design proposal outlined below, by cooling and drawing down clean air from 60m above street level (above the worst pollution levels), pollution is dissipated, and part of the heat cycle is broken. Once dissipated and dispersed, the pollutants will be safely broken down in the natural environment. The scheme below can be understood as the introduction of a negative feedback loop into the Athenian ecology, allowing the city to self regulate and maintain itself as an organism.



The Tower of Winds takes its name from a first century BC structure located next to the Roman Agora in the Plaka area, which contained a water clock, sundial, weather vane and compass. This proposal for a modern Tower of Winds has two orders of figuration within Athens. Firstly, as an object, it is a suspended fabric tower. The fabric is translucent/ transparent, and is decorated with a sophisticated opaque patterning, which incorporates PV fabric. The patterning varies across the height of the tower, and is designed to produce different shadow effects from the sun (depending upon the time and place) across the streets and buildings of the city. The cables which hold down the base of the tower are hollow and water is pumped up these tubes, which spiral up around the tower. These water tubes have small holes facing onto the inside which allow small amounts of water to weep out and run down the inside of the tower. This water evaporates, and because of the effect of the latent heat of evaporation, energy is taken out of the air inside the tower, and it cools. A draft is then created flowing down through the tower, and clean air is then drawn down through the top of the tower from above the pollution level.

As the worst pollution in Athens is primarily particles at or near street level, the air that is drawn down from 60m is relatively clean. The effects of evaporative cooling in the tower would be sufficient to generate a pleasant light breeze, and a temperature drop of around 11° C during the day. By cooling and drawing down clean air from 60m above street level (above the worst pollution levels), pollution is dissipated, and part of the heat cycle is broken. At night the process reverses and warm air generated from the heated urban fabric is funnelled away up the tower. If multiple towers were used throughout the Athenian summer, there would be a significant amelioration of the heat island effect, and a corresponding increase in public health. The form of the tower is a minimal surface (similar to those generated by engineer Frei Otto, by spinning an oil film. These forms have been demonstrated to generate the greatest airflow.



There have been a few crazy schemes proposed in recent years, which have suggested that the Acropolis should be covered in a glass box, to protect the buildings from corrosion during the most polluted periods. In this proposal, there is no need for such permanent constructions. Instead, on the worst pollution days, a pair of wind towers can be erected over the Acropolis, protecting it with an envelope of clean air rather than glass.

Footnotes to Introduction

[1] Roy Ascott, “Syncretic Fields: Art, Mind and the Many Realities”, lecture given on April 30, 2007, at Design Media Arts, UCLA. See Streaming Culture lecture series, accessed 14.5.09 http://dma.ucla.edu/events/calendar.php?ID=469

[2] Manfredo Tafuri, *The Sphere and the Labyrinth: Avant-Gardes and Architecture from Piranesi to the 1970s* (Cambridge, MA: MIT, 1987), p.2.

[3] I have taken the term “Critical Urban Ecology” from a symposium organised by Karin Jaschke held 8.12.10 at the University of Brighton which I gave a paper along with Doug Spencer and Ross Adams.

[4] Ilya Prigogine and Isabelle Stengers, *Order out of Chaos: Man’s new Dialogue with Nature* (London: Flamingo Fontana, 1985), p.9.

[5] John Briggs and F. David Peat, *Looking Glass Universe: The Emerging Science of Wholeness* (London: Fontana, 1984), p.179

[6] Tafuri, op.cit.

[7] Bruce Clarke and Mark B.N.Hansen (eds.), *Emergence and Embodiment: New Essays in Second-Order Systems Theory* (Durham, NC and London: Duke University Press, 2009), pp.1-2.

[8] The original proposal was informed by themes developed during the two masters degrees that I had completed in the previous decade. In the MSc in Computing and Design, led by Paul Coates at UEL, I had worked with digital scripting and parametric processes, and developed a thesis that touched upon complexity theory, emergence, non-standard mathematics, topology and perception, “inspired” in particular by Henri Poincaré, Robin Evans, and a reading of the concept of “nomadic science” found in Giles Deleuze and Felix Guattari’s *Mille Plateux*. A few years later, on the MSc Architectural History, led by Adrian Forty and Iain Borden, I attempted a critical reading of architectural expressionism – in both its historical avant-garde and contemporary forms – through a theory of “metropolitan prosthesis” and a conception of “empathising with abstraction”, based upon thinkers such as Walter Benjamin, Georg Simmel, and nineteenth-century and early-twentieth-century German aesthetics.

[9] This doctorate was thus initially conceived as a PhD by Design, and in many respects still is, although appears to all intents and purposes to have been submitted as a conventional thesis; the differences are getting narrower.

[10] See for example, David Harvey, *The Enigma of Capital* (London: Profile, 2010)

[11] Marx notes, in terms that bring to the fore the congruence between dialectical and cybernetic methods, that “individual moments ... determine each other internally and search for each other externally; but ... they may or may not find each other, balance each other, correspond to each other. The inner necessity of moments which belong together, and their indifferent, independent existence towards one another, are already a foundation of contradictions.” Karl Marx, *Grundrisse: Foundations of the Critique of Political Economy* (Harmondworth: Penguin, 1973), pp.414-15. Harvey cites this with regard to an early version of his co-revolutionary thesis in David Harvey, *Cosmopolitanism and the Geographies of Freedom* (New York: Columbia University Press, 2009), p.240.

Harvey develops his “method of moments” in particular out of a footnote at the beginning of the Chapter Fifteen on machinery in *Capital,* where Marx states that: “Technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby also lays bare the process of the production of social relations of his life, and of the mental conceptions that flow from these relations.” Karl Marx, *Capital Volume 1* (London: Penguin, 1990), p.493.

Footnotes to Chapter One

[1] However, as Reinholt Martin observed, and Murray Fraser has re-emphasised, aspects of cybernetics and systems theory in the west played a deeper role – which I would suggest was much closer to the Soviet impulse – that is, it aimed to form a body of knowledge that could act as a corrective mechanism, a means of grasping and bringing under control the relatively unplanned networks of capital – or was at least used to symbolise such control. See Reinhold Martin, *The Organisational Complex: Architecture, Media and Corporate Space* (Cambridge, MA: MIT Press, 2003). For a discussion around the role that cybernetics played in an immaterialisation of post-war Anglo-American construction, see Murray Fraser with Joe Kerr, *Architecture and the 'Special Relationship': The American influence on post-war British Architecture* (London: Routledge, 2007), pp.257-273.

[2] Hillier's theory of spatial configuration, although different in many ways (specifically, it is peculiarly ahistorical and apolitical) shares much with the relational approach to understanding architecture that I propose here. See Bill Hillier, *Space is the Machine: A Configurational Theory of Architecture* (Cambridge: Cambridge University Press, 1996). Hillier argues that architecture does not need to borrow paradigms from other disciplines, but if anything, helps to generate paradigms in other disciplines. He states that "the paradigm of architecture is a configurational paradigm" (p. 391) where configuration means "relations taking into account other relations" and which can be used to reveal the "elusive 'pattern aspect' of things in architecture"(p.1.) These "patterns" are for Hillier in a complex way socio-spatial mediations: "buildings seem to be physical things, and societies and organisations seem to be abstractions. Yet our ideas of buildings seem to contain social abstractions, and our idea of social organisations seems to contain ideas of buildings. The common coin of both relations seems to be the idea of space. Space both gives the form to the social abstractions which we name in buildings, and space seems to be the content of the building that can be taken back into more abstract conceptions of society and organisation" (p. 373).

For Hillier, "architecture is an inherently theoretical subject. The very act of building raises issues about the relations of the form of the material world and the way in which we live in it. ... architecture is the most everyday, the most enveloping, the largest and most culturally determined human artefact... architecture is abstract thought applied to building" (p.11). Paralleling in many respects the insights of Harvey and Lefebvre, although not mentioning either (and thereby missing any political or historical conception of relational spacetime as I hope to set it out below), Hillier observes that humans inhabit two types of world in parallel: "a continuous material world of objects and spaces which we occupy and move about in physically, and a discontinuous world of expressive forms, signs and symbols which we occupy cognitively. The former is real space the later logical space. Building is the meeting point of the two worlds, where real space is converted into logical space" (p.396).

[3] Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), p.220.

[4] See Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* (London: MIT Press, 1992).

[5] Since writing this thesis, Patrik Schumacher has published a major book on architecture and systems theory. It was published too late for me to incorporate a reading of it into this text, and unfortunately I was unaware of some papers that he had published which contained some of the material. However, suffice to say that following a somewhat cursory reading, I am sympathetic to many aspects of the book (and indeed I independently retrace aspects of his argument), even whilst I remain sceptical about its central claims regarding parametricism, and am concerned at the lack of clarity regarding the social and political import of its claims. Notably though, Schumacher does not make the observation that architecture has some kind of foundational role in systems theory (via Alberti).

[6] Manfredo Tafuri, *Interpreting the Renaissance: Princes, Cities, Architects* (Cambridge, MA: Yale University and Harvard University Graduate School of Design, 2006), p.xxix.

[7] William W. Braham and Jonathan Hale with John Stanislav Sadar (eds), *Rethinking Technology: A Reader in Architectural Theory* (London: Routledge, 2007) p.xv.

[8] Ibid., p.xv.

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[9] Braham and Hale open their reader book with a by now familiar quote from Illich, in which he states that “sometime during the 1980s the technological society which began in the fourteenth century came to an end ... the age of tools has now given way to the age of systems, exemplified in the conception of the earth as an ecosystem, and the human being as an immune system.” See Ivan Illich, *The River North of the Future: The Testament of Ivan Illich, as told to David Cayley* (Toronto: House of Anasazi Press, 2005), p.77. Illich’s notion that with the emergence of technological society came a shift in human consciousness, which he calls “instrumental causality”, is closely related to Gregory Bateson’s concept of “conscious purpose”. If tools extend the individual, systems might be said to engulf the individual. Illich suggests that “when you become the user of a system, you become part of the system.” A similar conception can also be found in Bernard Stiegler, who states that “like the machine, the human of the industrial age is dependent on the technical system, and serves it rather than making it serve itself; the human is the ‘assistant’... the means of technics qua system.” Bernard Steigler, *Technics and Time 1: The fault of Epimetheus* (Palo Alto, CA: Stanford University Press, 1998), p.vi.

I wonder whether seeing an immersion in systems as a wholly new condition is in fact overstating the situation. Any organism of course is always immersed in systems, and systems are surely only an intensified tool condition. We might more accurately say that the difference is that we are now primarily immersed in systems of our own making - although even that is to misunderstand how the systems that an organism is immersed in are in an important sense *always of its own making*. Nonetheless, it is clear that something needs to be accounted for, and one of the questions for us here is what does it mean for architecture when “the tools of design and construction, have become a matter of systems?”

[10] Although moves in that direction might include the work of Manuel de Landa, Bruno Latour and Isabelle Stengers.

[11] In many ways the broader discipline of ecology (including all of the sub or spin off disciplines such as human-, social-, deep-, political-) has come closest to this. However, there are of course enormous difficulties associated with such an interdisciplinary project. Discussing a key text of human ecology (Paul and Anne Ehrlich’s *Population, Resources, Environment*), Hans Magnus Enzensberger has noted, in a somewhat exasperated voice, that this work drew upon at least twenty different disciplines and that “it is hard to describe the methodological confusion that arises from a synthesis of this sort.” See Hans Magnus Enzensberger, ‘A Critique of Political Ecology’, in Ted Benton (ed.), *The Greening of Marxism* (London: Guilford Press, 1996), p.18.

[12] Roy Bhaskar, *Dialectic - The Pulse of Freedom* (London: Routledge. 2008), p.151.

[13] See David Pepper, *Eco-Socialism: From Deep Ecology to Social Justice* (London: Routledge, 1993), p.164.

[14] Richard Levins, ‘Dialectics and Systems Theory’, in Bertell Ollman and Tony Smith (eds), *Dialectics for the New Century* (New York: Palgrave Macmillan, 2008), p.26.

[15] Ibid., p.43.

[16] Actually, of course, Marx’s dialectical method moves in both directions, although it is the movement from abstract to concrete that has the ultimate importance, as it tests the theory in practice. As the Soviet dialectical theorist Evald Ilyenkov describes it: “one can say that the ascent from the concrete to the abstract and the ascent from the abstract to the concrete, are two mutually assuming forms of theoretical assimilation of the world, of abstract thinking. Each of them is realised only through its opposite and in unity with it. The ascent from the abstract to the concrete without its opposite, without the ascent from the concrete to the abstract would become a purely scholastic linking up of ready-made meagre abstractions borrowed uncritically. Contrariwise, a reduction of the concrete to the abstract performed at random, without a clearly realised general idea of research, without a hypothesis, cannot and will not yield a theory either. It will only yield a disjoint heap of meagre abstractions.” Evald Ilyenkov, *The Dialectics of the Abstract and the Concrete in Marx’s Capital* (1960) Accessed 14.4.11 from http://www.marxists.org/archive/ilyenkov/works/abstract/abstra3a.htm

[17] Bruce Clarke and Mark B.N.Hansen (eds.), *Emergence and Embodiment - New Essays in Second-Order Systems Theory* (Durham and London: Duke University Press, 2009), p.3.

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[18] Richard Levins, ‘Dialectics and Systems Theory’, in Bertell Ollman and Tony Smith (eds), *Dialectics for the New Century* (NY NY: Palgrave Macmillan, 2008), p.48.

[19] David Harvey, ‘Marxism, Metaphors, and Ecological Politics’, in *Monthly Review*, Volume 49, Number 11 (April 1998). Accessed 1.7.08 from http://www.monthlyreview.org/498harve.htm.

[20] David Harvey, *Cosmopolitanism and the Geographies of Freedom* (New York: Columbia University Press, 2009), p.137.

[21] Ibid., p.176.

[22] We should perhaps note straight away that this is already for some a controversial claim. The main challenge as articulated by Stuart Hampshire centres around questions of communicability: how can we agree what relations to include? Many of the “activist” and “actor” conversation theories that have emerged directly or indirectly from cybernetics (in different ways, notably including Pask, Glanville, Latour, and Delanda) do in fact resolve this issue in various ways. Others, such as Roy Bhaskar, argue for a combination of internal and external relations. For a discussion of internal relations see the chapter ‘In Defence of the Philosophy of Internal Relations,’ in Bertell Ollman, *Dance of the Dialectic: Steps in Marx’s Method* (Chicago: University of Illinois, 2003), pp.51-56.

[23] Ibid.

[24] Ibid.

[25] Ibid.

[26] Ibid., p.29.

[27] Bertell Ollman, ‘Why Dialectics, Why Now?’, in Bertell Ollman and Tony Smith (eds), *Dialectics for the New Century* (New York: Palgrave Macmillan, 2008), p.10.

[28] Ibid.

[29] Ibid., p.11.

[30] Yrjö Engeström, ‘Learning by Expanding: Ten Years After’ accessed on 5.4.11 at http://lchc.ucsd.edu/MCA/Paper/Engestrom/expanding/intro.htm

[31] In the terms of neocybernetics, this is similarto stating that architecture is an autopoietic practice and body of knowledge, even whilst it is structurally coupled to other systems in the world.

[32] Alfred North Whitehead, *The Concept of Nature* (Cambridge: Cambridge University Press, 1920), p.33 – as cited in David Harvey, *Cosmopolitanism and the Geographies of Freedom* (New York: Columbia University Press, 2009), p.133.

[33] David Harvey, ‘Space as a Key Word’ in *Spaces of Global Capitalism* (London: Verso, 2006), p. 119.

[34] Ibid.; See also Harvey, *Cosmopolitanism and the Geographies of Freedom*.

[35] Harvey of course notes that this matrix is itself as an absolute space, and therefore has “limited revelatory power.” Nonetheless, it is useful “as a way to jump-start the analysis.” See Harvey, *Cosmopolitanism and the Geographies of Freedom*, p.145.

[36] According to Harvey, in these classifications Lefebvre used without reference Ernst Cassirer’s tripartite division of human spatial experience into *organic*, *perceptual* and *symbolic* spaces. See Ernst Cassirer, *An Essay on Man: An Introduction to a Philosophy of. Human Culture* (Garden City, NY: Doubleday Anchor Books, 1953) For Harvey writing on Cassirer’s modes of space, see Harvey, ‘Space as a Key Word’, pp.129-30.

[37] Harvey, *Cosmopolitanism and the Geographies of Freedom*, p.142.

[38] Ibid.

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[39] Harvey, *Social Justice and the City*, p.13.

[40] Harvey, *Cosmopolitanism and the Geographies of Freedom*, p.134.

[41] Ibid., p.136.

[42] David Cunningham, 'The Concept of Metropolis: Philosophy and Urban Form', in *Radical Philosophy* 133 (2005), p. 20.

[43] Harvey, *Cosmopolitanism and the Geographies of Freedom*, p.137.

[44] Ibid.

[45] Harvey, 'Space as a Key Word', p.125.

[46] Ibid.

[47] Harvey, *Cosmopolitanism and the Geographies of Freedom*, p.150.

[48] Harvey, 'Space as a Key Word', p.145.

[49] Harvey, 'Dialectics of Spacetime', p.103.

[50] Ibid.

[51] Rem Koolhaas, as cited in David Cunningham's preface to 'Propaganda Architecture: Interview with Rem Koolhaas and Reinier de Graaf', conducted by David Cunningham and Jon Goodbun, in *Radical Philosophy* 154 (March/April 2009), p.36.

[52] Ernst Haeckle, as cited in Reiner Grundmann, *Marxism and Ecology*, (Oxford: Clarendon, 1991), p.1.

[53] McKee, as cited in T. J. Demos, 'The Politics of Sustainability: Art and Ecology', in *Radical Nature: Art and Architecture for a Changing Planet 1969–2009* (London: Barbican Art Gallery, 2009) p.17.

[54] Harvey, 'Space as a Key Word', p.138.

[55] Bertell Ollman, 'Why Dialectics, Why Now?', in Ollman and Smith (eds), *Dialectics for the New Century*, p. 12.

[56] T. J. Demos, 'The Politics of Sustainability' in *Radical Nature*, p.17.

[57] See Félix Guattari, *The Three Ecologies* (London & New Brunwick, NJ: Athlone Press, 2000).

[58] See footnote 11 above.

[59] Fritjof Capra, *Uncommon Wisdom: Conversations with Remarkable People* (London: Century, 1988), p.70.

[60] Roy Bhaskar, *Dialectic - The Pulse of Freedom* (London: Routledge. 2008), p.54.

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[1] This kind of project is being discussed for instance within the ECHO (Ecological History) initiative started by Karin Jaschke. More broadly examples of this kind of thinking can be found in the work of theorist-historians such as Matthew Gandy, and the emerging Urban Political Ecology discourse.

[2] Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), p.220.

[3] David Pepper, *Modern Environmentalism: An Introduction* (London: Routledge, 1996), p.168.

[4] Susannah Hagan suggests: "The roots of culture have of course always lain in nature, literally, in the way something like agriculture has transformed the wilderness into cultivated fields, and metaphorically, in the way nature has served, for example, as a model for the religious mythology of death and rebirth in the coming of spring after winter. Historically, in the west, this binary – nature/culture – has been bound up with another equally valued binary – female/male – which may have some bearing on the prevalent perception of environmentalism as 'soft ' scientifically and intellectually. That is, nature, in the west, has been seen as female and inferior, and culture has been seen as male and superior." Susannah Hagan, *Taking Shape: A new contract between architecture and nature* (Oxford: Architectural Press, 2001), p.19.

[5] Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (Glasgow: Fontana, 1976), p. 184.

[6] Ibid., p.185.

[7] Williams tells of an amusing series of personifications of nature: through goddess, to mother nature, to something like an absolute monarch. Then, "paralleling political changes", nature shifts in conception "from an absolute to a constitutional monarch, with a new kind of emphasis on natural laws,"... and in the eighteenth and nineteenth centuries becomes a constitutional lawyer ... "shaping new laws from new cases." In its 'constitution' it became contrasted with what was made by man – a "state of nature" opposed to a "state of society" – and it finally arrives at nature the selective breeder.

[8] Neil Smith and Phil O'Keefe, 'Geography, Marx and the Concept of Nature', in *Antipode,* vol.12, 1989, pp.30-39.

[9] Kate Soper, *What is Nature? Culture, Politics and the non-Human* (Oxford: Blackwell, 1995), p.2.

[10] Neil Smith, *Uneven Development: Nature, Capital and the Production of Space - 3rd Edition* (Oxford: Basil Blackwell, 2008), p.11.

[11] Ibid.

[12] Neil Smith, 'Foreword', in Nik Heynen, Maria Kaika and Eric Swyngedouw (eds), *In the Nature of Cities: Urban Political Ecology and the politics of Urban Metabolism* (London: Routledge, 2006), p.xiii-xiv.

[13] Smith, *Uneven Development,* p.11.

[14] Forty, *Words and Buildings*, p.220. Forty does in fact refer to both Smith and Harvey in this chapter ('Nature').

[15] Of course, there is much more that can be said about the nature/culture opposition than I have space to cover here. It has emerged as a big question in contemporary sociology (Bruno Latour, Nigel Thrift etc) semi-independently of the centrality of the question to systems theory, ecology and cybernetics. In the natural sciences too it has emerged. It is worth noting for example that the original 1979 French edition of Ilya Prigogine and Isabelle Stengers, *Order out of Chaos - Man's New Dialogue with Nature* (London: Flamingo Fontana, 1985) was *La Nouvelle Alliance*. The new alliance alluded to in this title was of course between humanities and sciences, based around "science's rediscovery of time".

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[16] The role that questions of nature and the environment play within Marx's thought has been the subject of much investigation. Whilst there has no doubt been some decline in work on the broader question of "nature" in recent years, there is a growing body of new research in relation to contemporary political ecology.

The use of process and systems thinking in Marx, and specifically the question of whether Marx developed an ecological model of philosophy, and also the broader question concerning the role that nature plays in Marx's thought, have been a matter of keen debate since Marx's death. I will refer to the broader question concerning Engels and the *Dialectics of Nature* in footnote 17 below.

In the 1970s, the general rise of the environmental movement provoked a new engagement with these questions, and, out of this period, a new generation of thinkers emerged. These included works from critical geography David Harvey (*Justice, Nature and the Geography of Difference*, 1996), and his former student Neil Smith (*Uneven Development: Nature, Capital and the Geography of Space,* 1984); their work is characterised by a materialist dialectic and an engagement with, and extension of, Lefebvre's work on the role of space in the processes of capital. David Pepper is also a geographer, but his work has focused on charting the relationship between Marxian theory and the broader network of ideas and traditions active within the environmental movement (*Modern Environmentalism: An Introduction*, 1996). Ted Benton (*The Greening of Marxism*, 1996) and Kate Soper (*What is Nature?*, 1995) were both members of the editorial collective behind the journal *Radical Philosophy*, and this provided a primary platform of discussion, for a period, for both of these thinkers and others on these questions. Ted Benton, in particular, through the Red-Green Study Group, has continued to engage these questions in a variety of ways. James O'Connor's influential thesis that ecological crisis is 'The Second Contradiction of Capitalism' provoked responses that Benton's edited collection, *The Greening of Marxism*, provided a third of its space to debate.

Alfred Schmidt (*On the Concept of Nature in Marx and Engels*, 1971) was a student of Adorno and Horkheimer at Frankfurt, and his excellently comprehensive and exhaustive assemblage of almost any reference to "nature" in the texts of Marx and Engels was presented within a Frankfurt School framework (this reading has been challenged in particular by Neil Smith above). Reiner Grundmann (*Marxism and Ecology,* 1991) and Howard L Parsons (*Marx and Engels on Ecology,* 1977) are both insightful if fairly orthodox accounts, characteristic of their periods. From biology, Richard Levins and Richard Lewontin (*The Dialectical Biologist*, 1985) and Stephen Jay Gould (*An Urchin In The Storm*, 1987) represent the minority of contemporary practising natural scientists who have considered their craft from a dialectical position.

More recently, John Bellamy Foster (*Marx's Ecology: Materialism and Nature*, 2000, and several other books) has presented one of the most comprehensive accounts of ecological thinking in Marx, whom he presents as a proto-ecological philosopher, and argues for the urgent need to re-introduce Marxian analysis into the broader environmental debate. Foster also edits the leftist journal *Monthly Review*, which frequently covers environmental politics. Joel Kovel (*EcoSocialist Manifesto*, (co-written with Michael Löwy) 2001 - accessed 28.8.10 from http://www.ecosocialistnetwork.org/Docs.htm) has contributed much to the red/green question, and edits the journal *Capitalism, Nature, Socialism*. Paul Burkett (*Marx and Nature: A Red and Green Perspective*, 1999, and *Marxism and Ecological Economics: Towards A Red and Green Political Economy*, 2006) has very usefully engaged with a series of concepts that have emerged from ecological economics, such as "natural capital" and "entropy" in economic energetics. A very good bibliography up to the millennium has been produced by Joan Nordquist, *Marxism and Ecology: A bibliography* (Santa Cruz CA: University of California Santa Cruz Reference and Research Services, 1999).

[17] David Harvey, *Reading Marx's Capital Lesson 5.* Accessed on 1.8.2008 from www.davidharvey.org

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[18] There are I think a number of serious misconceptions – both factual and conceptual – surrounding a collection of manuscripts of Engels which he had proposed to develop into a book called *Dialectics of Nature (DoN)*. Engels himself never actually published these (indeed a significant amount of the text remains little more than notes), although they were eventually published in the Soviet Union and Germany in 1925. Certainly, within western Marxist theory, there has been a strong tendency to dismiss this work as something that Engels alone was engaged in, after Marx's death in 1883. Engels' project here is often described as an attempt to expand dialectical thought into areas for which it was not suited. John Bellamy Foster has noted that according to the standard commentary, it is "as if he [Engels] alone, and not Marx, was responsible for the existence of a materialist conception of nature within Marxism" (John Bellamy Foster, *Marx's Ecology* (New York: Monthly Review Press, 2000) p.7). This kind of position is arguably problematic for a number of reasons. Firstly, if anything, it is more accurate to state that Engels *stopped* working on the *Dialectics of Nature* project once Marx died! There are several reasons why Engels never completed and published the *DoN,* not least that after Marx's death, his time was largely devoted to trying to organise and publish the remaining *Capital* manuscripts (publishing *Capital Volume 2* in 1885, and *Volume 3* in 1894).

Indeed, according to Haldane's 1939 preface, all of the *DoN* manuscripts were produced between 1872-1882. Although the manuscript is almost entirely in Engels' handwriting, Marx has added a series of quotes from Greek philosophers (so he was clearly aware of it). Furthermore Marx was certainly familiar with Engel's *Anti-Dühring* text (which rehearses many of the same arguments). Finally, as Foster notes, the notion that a dialectical naturalism is an obsession of Engels alone is finally refuted by the publications of Marx's scientific journals (see *MEGA (Marx-Engels-Gesammtausgabe) IV/31: Natural-Science Notes of Marx and Engels, 1877-1883*, published in 1999 by Internationale Marx-Engels-Stiftung (IMES)). Rather than perpetuating the notion that Marx was exclusively concerned with social dialectics, and Engels later extended this approach into natural science, it is perhaps more accurate to conceive of a division of labour between the two men. As the biologist J B S Haldane noted in his 1939 preface to *Dialectics of Nature,* Marxists "show how the scientific activities of any society depend on its changing needs, and so in the long run on its productive methods, and how science changes the productive methods, and therefore the whole society. This analysis is needed for any scientific approach to history, and even non-Marxists are now accepting parts of it. But secondly Marx and Engels were not content to analyse the changes in society. In dialectics they saw the science of the general laws of change, not only in society and in human thought, but in the external world which is mirrored by human thought. That is to say it can be applied to problems of "pure" science as well as to the social relations of science." (accessed from http://marxists.org/archive/marx/works/1883/don/preface.htm)

Whilst the possibility of a 'dialectics of nature' might be debated, it seems indisputable that Marx supported such a project. Exactly how to conceive of the relations between 'the three ecologies' of dialectical thought – natural, personal, social – is beyond the scope of this commentary. However, it seems to me that Marxist studies might learn much from the way in which similar questions have been approached in second order systems thinking, for example.

The rejection of a dialectical conception of nature is generally situated with the early Lukács. Just as important perhaps was the fact that, in the Soviet Union, Stalin promoted a dogmatic version of materialist dialectics called *diamat* - from 'dialectical materialism' - a term coined by both Dietzgen and Kautsky in 1887. John Bellamy Foster argues that in Western Marxism's critique of nineteenth-century positivism – i.e. the attempt to deterministically transfer a mechanistic scientific approach to social sciences – the possibility of a materialist naturalism was also rejected. Foster argues that Western Marxism took an *idealist* turn, based on the false notion that "the social world was constructed in the entirety of its relations by human practice". (John Bellamy Foster, *Marx's Ecology* (New York: Monthly Review Press, 2000), p.7).

Roy Bhaskar describes what he calls "the possibility of naturalism" as "the thesis that there is (or can be) an essential unity of method between the natural and the social sciences." He has usefully suggest that we might conceive of three forms of materialism at work in Marx's thought:

> "1. Ontological Materialism, asserting the unilateral dependence of social upon biological (and more generally physical) being and the emergence of the former from the later;
> 2. Epistemological Materialism, asserting the independent existence and transfactual [that is, causal and lawlike] activity of at least some of the objects of scientific thought
> 3. Practical Materialism, asserting the constitutive role of human transformative agency in the reproduction and transformation of social forms" (Roy Bhaskar, "Materialism," in Tom Bottomore, (ed.), *A Dictionary of Marxist Thought* (Oxford: Blackwell, 1983), p. 324).

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[19] See for example David Harvey's comments on Engels, the physicists David Bohm and David Peat, and biologists Richard Levins and Richard Lewontin (all in relation to dialectical relational processes 'in nature'), in David Harvey, *Justice, Nature and the Geography of Difference* (Oxford: Blackwell, 1996), pp. 57-59.

[20] Karl Marx, *Economic and Philosophic Manuscripts of 1844* (accessed 1.8.09 http://www.marxists.org/archive/marx/works/1844/manuscripts/labour.htm)

[21] For example, Marx states "labour is, first of all, a process between man and nature, a process by which man, through his actions, mediates, regulates and controls the metabolism between himself and nature." Karl Marx, *Capital Volume 1* (London: Penguin, 1990), p.283.

[22] Harvey goes on to say that "this leads me to make strong propositions of the sort: any ecological project is always a social project, all social projects are ecological projects, you cannot view them as separate from each other..." Harvey, *Reading Marx's Capital Lesson 5.*

[23] Although the role of time was well established in the earliest political economy, and they do not add to that, but rather recast time in a series of different productive relations with space.

[24] Smith, *Uneven Development*, p.8.

[25] Harvey, *Reading Marx's Capital Lesson 5.*

[26] Deep Ecology is a philosophical position most closely associated with Arne Naess, although other figures such as Fritjof Capra also use the term to describe their (closely related) positions. Naess also referred to Deep Ecology as Ecosophy, a term which Felix Guattari also uses in *The Three Ecologies*, without reference (or direct relation) to Naess.

[27] Marx, *Capital Vol. 1*, p.284.

[28] Pepper, *Modern Environmentalism*, p.168.

[29] Neil Smith, 'Foreword', in Heynen, Kaika and Swyngedouw (eds), *In the Nature of Cities*, p.xi.

[30] David Pepper, *Eco-Socialism: From Deep Ecology to Social Justice* (London: Routledge, 1993), p.109.

[31] A collection of Aristotle's writings was called the *Organon* (i.e. they constituted an intellectual tool). Aristotle did also use *organon* to refer to biological organs. Francis Bacon referred to his philosophy as the *Novum Organum* (1620), and the Russian mystic philosopher and student of G.I. Gurdjieff, P.D. Ouspensky, referred to his 1912 philosophical synthesis as the *Tertium Organum*. Another of Gurdjieff's students, Olgivanna Hinzenberg, married Frank Lloyd Wright, and she introduced the two, and through this Gurdjieff also came to influence Wright's conception of organic.

[32] North's 1569 translation of Plutarch, in Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (Glasgow: Fontana, 1976), p.190.

[33] Harvey, *Reading Marx's Capital Lesson 5.*

[34] Immanuel Kant, *Critique of Judgement* (Indianapolis: Hackett, 1987) p.253. Quoted in Fritjof Capra, *The Web of Life: A New Synthesis of Mind and Matter* (London: Flamingo 1996), p.21.

[35] Rykwert's essay on 'Organic and Mechanical' provides a useful review of this term. See Joseph Rykwert, 'Organic and Mechanical', in William W. Braham and Jonathan Hale with John Stanislav Sadar (eds), *Rethinking Technology: A Reader in Architectural Theory* (London: Routledge, 2007), pp.337-349.

[36] Murray Bookchin, *Post Scarcity Anarchism* (Stirling: AK Press, 2004), p.24.

[37] Williams, *Keywords*, p.191.

[38] Pepper, *Modern Environmentalism*, p.134.

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39 For example consider Goethe's statement that: "each creature is a patterned gradation of one great harmonious whole". Quoted in Capra, *The Web of Life*, p.21.

40 Friedrich Wilhelm Joseph Schelling, quoted in Rykwert, 'Organic and Mechanical', in Braham and Hale with Sadar (eds), *Rethinking Technology*, p.339.

41 Ibid.

42 Pepper, *Modern Environmentalism*, p.5.

43 Ibid.

44 See Pepper, *Modern Environmentalism*, p.162.

45 And more generally the wide range of non-conformist spiritual-political sects that proliferated in particular in east London, through the seventeenth to nineteenth centuries.

46 See Pepper, *Modern Environmentalism,* p.162

47 Ibid., p.134

48 Georg Lukács, 'Preface' in *Studies in European Realism* (London : Hillway, 1950) (accessed 26.8.10 from http://courses.essex.ac.uk/lt/lt204/lukacs_preface.htm)

49 Indeed, as Gregory Bateson notes, "it would not be wise (even if possible) to return to the innocence of the Australian aborigines, the Eskimo, and the Bushmen. Such a return would involve loss of the wisdom which prompted the return and would only start the whole process over." Gregory Bateson, 'Ecology and Flexibility in Urban Civilisation' in *Steps to an Ecology of Mind* (Chicago and London: University of Chicago Press, 2000 [originally published 1972]), p.503.

50 Michael Löwy, 'Naptha or Settembrini? Lukács and Romantic Anticapitalism' in Judith Marcus, Zoltán Tarr (eds.), *Georg Lukács: theory, culture, and politics* (New Brunswick: NJ, 1989) p.192. Löwy notes that Lukács model of an organic community shifts from Homeric Greece and the Christian Middle Ages in *The Theory of the Novel* (1916) to Greece and the Renaissance in *History and Class Consciousness* (1919).

51 Ernst Haeckel, *General Morphology of Organisms; General Outlines of the Science of Organic Forms based on Mechanical Principles through the Theory of Descent as reformed by Charles Darwin* (Berlin, 1866) cited in Jonathan Olsen, *Nature and Nationalism: Right-Wing Ecology and the Politics of Identity in Contemporary Germany* (New York: St. Martin's Press, 1999), p.68.

52 Although the environment as a concept was not properly defined until later, "Umwelt", or "environment" was first coined in an ecological sense by Jakob von Uexküll in 1909 (according to Capra, p.33). As later did his student Hans Driesch, Haeckel developed a form of vitalism which was related to his conception of environment. They correctly identified that there was some kind of relationship between an organism and its surroundings, and that organisms embodied a wholeness in their organised production mechanisms which could not be explained on a mechanistic basis from their parts. However, his model of ecology contained flaws. He conceived of the environment as having a causal determining effect on the organism. Tansley has since shown that organisms themselves participate in complex ecosystems, and Maturana and Varela have since shown that the relationship between an organism and an environment is not causal, but is a complex co-evolution. J.J. Gibson gives a clear sense of the specific meaning of environment: "it is often neglected that the words animal and environment make an inseparable pair. Each term implies the other. No animal could exist without an environment surrounding it. Equally, although not so obvious, an environment implies an animal (or at least an organism) to be surrounded. This means that the surface of the earth, millions of years ago before life developed on it, was not an environment properly speaking. The earth was a physical reality, a part of the universe, and the subject matter of geology. It was a potential environment, prerequisite to the evolution of life on this planet. We might agree to call it a world, but it was not an environment." James J. Gibson, *The Ecological Approach to Visual Perception*, (Houghton Mifflin: Boston, 1979), p.8.

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[53] For a discussion of Marx and Engels' evolving commentary on Haeckel (and Darwin), see Jean-Guy Vaillancourt, 'Marxism and Ecology: More Benedictine than Franciscan', in Ted Benton (ed.), *The Greening of Marxism* (London: Guildford Press, 1996), pp.50-63.

[54] It is worth noting that Charles Darwin took the phrase "survival of the fittest" from Herbert Spencer, who was developing an evolutionary theory of human society.

As Marx notes regarding Darwin, in a letter to Engels, "it is noteworthy that Darwin rediscovers in animals and plants his own English society with its social division of labour, competition, the opening up of fresh markets, intervention and the Malthusian struggle for existence. This is the *bellum imnium contra omnes* of Hobbes." Letter from Marx to Engels, 18th June, 1862, in Karl Marx and Frederick Engels, *Collected Works* (New York: International Publishers, 1975) Vol. 41, p.381. "Bellum imnium contra omnes" translates as "the war of all against all," and was used by Hobbes to describe an imagined state of humanity in a natural, pre-civilised condition. Engels would later take this further in considering the Social Darwinists: "The whole Darwinian theory of the struggle for life is simply the transference from society to organic nature ... of the bourgeois economic theory of competition. Once this feat has been accomplished ... it is very easy to transfer these theories back again from the natural world to the history of society, and altogether too naïve to maintain that thereby these assertions have been proved as eternal laws of society." Frederick Engels, *The Dialectics of Nature* (London: WellRed, 2006) p.313.

[55] It is worth noting that this was finally disproved by genomic science in recent years.

[56] For a general discussion of Haeckel and associates in this regard, see Jonathan Olsen, *Nature and Nationalism: Right-Wing Ecology and the Politics of Identity in Contemporary Germany* (New York: St. Martin's Press, 1999)

[57] Key contributors would certainly include Francis Bacon, Nicolaus Copernicus, Johannes Kepler and Galileo Galilei.

[58] Isaac Newton, *Optiks*, as cited in M P Crosland (ed.), *The Science of Matter* (Harmondsworth: Penguin, 1971), p.76.

[59] Pierre Simon Laplace, *A Philosophical Essay on Probabilities*, trans. Frederick Wilson Truscott and Frederick Lincoln Emory (New York: Dover, 1951), p.4.

[60] In fact, as Neil Smith notes, in this move Newton is actually anticipating later developments, in ways that would be important for a critical dialectics. For Smith, "Newton opened up the possibility that space and time, not matter, are the basic elements of nature... Thus we can speculate that connected with an ideology of nature will be an ideology of space." Smith, *Uneven Development*, p. 16.

[61] The vitalist concept of "*elan vital*" was formulated by Henri Bergson. For a discussion of the largely Bergsonian legacy of most contemporary philosophical variants of Bergson (post-Deleuze), with reference to Maturana, Varela, Capra and Clark, see Sean Watson 'The New Bergsonism - Discipline, Subjectivity and Freedom' in Radical Philosophy, no.92, November/December 1998, pp. 6-16.

[62] Rupert Sheldrake, *The Presence of the Past* (Vermont: Park Street Press, 1995), p.83.

[63] See Capra, *The Web of Life*, p.26.

[64] Ibid., p.25.

[65] See Lois N. Magner, *A History of the Life Sciences* (New York: Marcel Dekker, 2002), and Roger Wolcott Sperry and Colwyn Trevarthen, *Brain circuits and functions of the mind: essays in honor of Roger W. Sperry* (Cambridge: Cambridge University Press, 1990).

[66] See for example Lawrence Henderson, *The Fitness of the Environment* (New York: Macmillan, 1913), which he considered to be "an inquiry into the biological significance of the properties of matter".

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[67] It was Christian von Ehrenfels, who introduced gestalt to philosophy and psychology, who coined the phrase the ‘whole is more than the sum of parts’, in *On the Qualities of Form* (1890).

[68] For a discussion of both relativity and quantum theory in this regard, see John P, Briggs and F. David Peat, *Looking Glass Universe - The Emerging Science of Wholeness* (NY: Touchstone, 1984)

[69] Niels Bohr, *Atomic Physics and the description of Nature* (Cambridge: Cambridge University Press, 1934), p.57.

[70] Henry Stapp, ‘S-Matrix interpretation of Quantum Theory’, *Physical Review*, vol D3 (15.3.71), p. 1310.

[71] Fritjof Capra, *The Tao of Physics - A Study of the Parallels between Modern Physics and Eastern Mysticism* (London: Flamingo, 1991), p.363.

[72] Alfred North Whitehead, *Science and The Modern World* (New York: The Free Press,1967), p.91.

[73] Ibid., p.150.

[74] In Isabelle Stengers, ‘Whitehead and Science: from philosophy of nature to speculative cosmology’ (unpublished paper) accessed 28.8.10 from http://www.mcgill.ca/files/hpsc/Whitmontreal.pdf

[75] David Bohm in interview with F. David Peat and John Briggs for Omni magazine, accessed 28.8.10 from http://www.fdavidpeat.com/interviews/bohm.htm

David Bohm was a PhD student at Princeton under Oppenheimer and Einstein. Bohm was however, a radical thinker, both politically and philosophically, and was associated with several radical student groups, notably the Communist Youth League. As Oppenheimer became involved in the Manhattan Project, Bohm himself came to the attention of the MacCarthyist witch-hunts. Paradoxically, he was banned from completing his PhD research on the grounds that he would not have security clearance to read it! Whilst Stalin’s dictatorship ultimately led to a disillusionment with Marxism, he continued to study Hegelian philosophy throughout his life. Indeed Bohm’s collaborator David Peat recalls (in as yet unpublished interview with myself) that his last conversation with Bohm, shortly before his death, concerned Hegel. His thoughts on Whitehead are captured at several points in his correspondence with the artist Charles Biederman, to whom he states early on that “with regard to your request for books about this view on creativity in nature, it is hard to suggest anything, as few people hold these views at present. I would suggest your reading Whitehead as the nearest approximation that I know of. For example, try his book ‘Process and Reality’.” Paavo Pylkkänen (ed.), *David Bohm and Charles Biedeman, Bohm Biederman Correspondence - Vol. 1 Creativity and Science* (London and New York: Routledge, 1999), p.73.

[76] I take this phrase from Andrew Pickering’s description of Stafford Beer. Pickering states that “... hylozoism, for me, refers to a kind of spiritually charged wonder at the performativity and agency of matter, and Stafford Beer was certainly a hylozoist under this definition.” Andrew Pickering, ‘Brains, Selves and Spirituality in the history of Cybernetics’, paper given at Templeton Workshop, ‘Transhumanism and the Meanings of Progress,’ Arizona State University, 24-25 April 2008. Accessed on 1.3.10 from eric.exeter.ac.uk/exeter/bitstream/10036/81576/1/ASU-spirit.pdf

[77] I am thinking here in particular of important strands in recent ecological thought, developed in different ways by thinkers such as Ralph Abraham, Gregory Bateson, Stafford Beer, David Bohm, Fritjof Capra, Brian Godwin, Stephan Harding, Stuart Kauffman, James Lovelock, Lynn Margulis, David Peat, Ilya Prigogine, Carl Sagan, Rupert Sheldrake, Isabelle Stengers, Evan Thompson, William Irving Thompson and Francisco Varela, which have in places approached becoming new forms of panpsychism. Whilst this quickly drawn list might include others, and whilst different readers might eject some thinkers entirely, even the most hard nosed rationalist would have to recognise the curious hylozoist pattern that connects this modern “natural philosophy”.

[78] This question has I realise, been approached in sociology by thinkers such as Nigel Thrift and Bruno Latour through the concept of agency.

[79] Rupert Sheldrake, *The Presence of the Past* (Vermont: Park Street Press. 1995), p.54.

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[80] Arne Naess, *Ecology, Community and Lifestyle* (Cambridge: Cambridge University Press, 1989), p.79.

[81] Harvey, *Justice, Nature, and the Geography of Difference*, p.47.

[82] Ibid., p.198.

[83] Alan Woods and Ted Grant, *Reason in Revolt: Marxist Philosophy and Modern Science* (London: Well Red Books, 2007) p.64.

[84] David Bohm, *Wholeness and the Implicate Order* (London: Routledge, 1980), p.167

[85] David Bohm in interview with F. David Peat and John Briggs for Omni magazine, accessed 28.8.10 from http://www.fdavidpeat.com/interviews/bohm.htm.

[86] Norbert Weiner, *The Human use of Human Beings: Cybernetics and Society* (NY: Da Capo, 1988) p.96.

[87] Prigogine and Stengers, *Order out of Chaos*, p.9.

[88] Ibid., pp.14-17.

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[1] Francisco J. Varela, ‘Organism: A Meshwork of Selfless Selves’ in Alfred I Tauber (ed.), *Organism and the Origins of Self* (Dordrecht: Kluwer Academic Publishing, 1991), p.79.

[2] David Harvey, ‘Marxism, Metaphors, and Ecological Politics’ in *Monthly Review*, (Vol. 49, No. 11, April 1998). Accessed from http://www.monthlyreview.org/498harve.htm. The full quote reads:

“I here learn a great deal from trying to understand ecocentric lines of thought and the works, for example, of deep ecologists, land ethicists, and animal rights theorists. I may not accept their views but I do respect them and try as faithfully as I can to transcribe and translate their thoughts into my own resolutely anthropocentric and Marxian framework. They help concentrate my mind on the qualitative as well as the quantitative conditions of our metabolic relation to the world and raise important issues about the manner of relating across species and ecological boundaries that have traditionally been left on one side in many Marxist accounts.

I am aided in this by a striking parallel between a relational version of dialectics (which has always been central to my own interpretation of the Marxian tradition) and many other forms of environmental discourses. From deep ecology and other "green" critiques of Enlightenment and Cartesian instrumentality (including those developed in ecofeminism) I find sustenance for a more nuanced dialectical and process-based argument concerning our positionality in the natural world. Writers as diverse as Whitehead and Cobb, Naess, and Plumwood have something important to say on this and I do not find it impossible to translate at least some of what they say into the language of a relational Marxism. This does not lead me to accept some of the more strident rejections of Enlightenment thought (indeed, I think on balance it was positive and liberatory), but it reinforces a rejection of mechanistic and positivist accounts of our postionality in and relation to the rest of the natural world that have often infected Marxism as well as conventional bourgeois forms of analysis.”

[3] Lewontin notes that “the troubling of a flower is felt on the farthest star”, in principle, but it is not a serious problem of cosmology. So, we search for an intellectual mode that is neither atomistic nor holistic ... [T]his search has led in recent years, to a renaissance of interest in dialectics, drawing its inspiration either directly from Hegel or else indirectly and transformed by Engels’ Dialectics of Nature.” Richard Lewontin, ‘Foreword’ in Tauber (ed.), *Organism and the Origins of Self*, p.xvii.

[4] Richard Lewontin quoted in Varela ‘Organism: A Meshwork of Selfless Selves’, p.79.

[5] I suggest that just as Harvey suggests bridges between Marxian traditions and ecocentric thinking, there might be enormous value to be had from an explicit Marxian “conversataion” with the neocybernetics of Varela and Thompson in particular.

[6] Humberto Maturana and Francisco Varela state that “living systems are ... physical autopoietic machines: they transform matter into themselves in a manner such that the product of their operation is their own organisation.” They go on to argue that the converse is also true: “A physical system if autopoietlc is living. In other words, we claim that the notion of *autopoiesis is necessary and sufficient to characterise the organisation of living systems*.” Humberto Maturana and Francisco Varela, *Autopoiesis and Cognition: The Realization of the Living* (Dordrecht, Holland: D. Reidel Publishing, 1980), p.82. Likewise, the “cell metabolism produces components which make up a network of transformations that produced them. Some of these components form a boundary, a limit to this network of transformations. In morphologic terms, the structure that makes this cleavage in space possible is called a membrane.. the membrane not only limits the extension of the transformation network that produced its own components but it participates in this network. If it did not have this cellular arrangement, cell metabolism would disintegrate in a molecular mess ... [this is] not a sequential process, but two aspects of a unitary phenomenon.” Humberto Maturana and Francisco Varela, *The Tree of Knowledge* (Boston: Shambhala Publications, 1987) pp.44-6.

Metacellularity, or second-order autopoiesis, is defined as operating where a large number of first-order autopoietic unities are all reciprocally structurally coupled. Symbiosis is defined as a form of metacellularity where one autopoietic unity operates within the boundaries of another.

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[7] Structural Coupling occurs “whenever there is a history of recurrent interactions leading to the structural congruence between two (or more) systems.” Every unity has an environment. If this is constant and there are consistent interactions, then they will couple. However, “the structure of the environment only triggers structural changes in the autoppoietic unities (it does not specify or direct them), and vice versa for the environment. The result will be a history ...” (Maturana and Varela, *The Tree of Knowledge*, p.75.) Structural Coupling is technically defined by Maturana and Varela as “phylogenetic and ontogenetic drift with conservation of adaption.” (Ibid., p.29.) This defines how different autopoietic systems shape each other’s environments, in such a way that both (or more) depend on each other for continuing autopoiesis. ‘Irritation’ between systems is key to development and coupling. For example, in Niklaus Luhmann’s account of the structural coupling between different social systems, technology, communications, economy etc are all separate but structurally coupled autopoietic systems. Moeller describes Luhmann’s account well: ”from the point of view of social systems theory, the impact of technology on society cannot be predicted because technology cannot directly cause social change. Structural changes in communication are made by communication itself. Yes, technology made society change, but it made society change itself.” (Hans-Georg Moeller, *Luhmann Explained: from Souls to Systems* (Chicago and Las Salle: Open Court, 2006), p.125.) This account is fantastically useful in thinking about the nature of the autonomy of architecture I would suggest. Using a Luhmann-based approach, we can understand architecture (or art) as a properly autonomous and autopoietic system, at one level of activity, yet simultaneously structurally coupled to other systems, such as the rest of the economy, or technology, etc.

[8] Co-evolution is a term that that Bateson defined to describe the development of the relation between an organism and an environment – a relation which for Bateson was the real unit of survival as opposed to the neo-Darwian descriptions of an organism’s ‘adaption to’ and ‘selection by’ an environment (Darwin himself in fact described evolution “as if” selection were occurring). Maturana and Varela take on Bateson’s term (and critique of Darwinism) and use it to describe the general effects of structural coupling (see next footnote). Co-evolution is also further developed by Erich Jantsch in particular, in relation to Ilya Prigogine’s concept of dissipative structures. See Erich Jantsch, *The Self-Organising Universe - Scientific and Human Implications of the Emerging Paradigm of Evolution* (London: Pergamon, 1980).

[9] Natural drift describes the history of an autopoietic organism structurally coupled to an environment. They state that “the adaptation of a unity to an environment, therefore, is a necessary consequence of that unity’s structural coupling with that environment; and this should not be surprising. In other words, every ontogeny as an individual history of structural change is a structural drift that occurs with conservation of organisation and adaption ... conservation of autopoiesis and conservation of adaption are necessary conditions for the existence of living beings; the ontogenetic structural change of a living being in an environment always occurs as a structural drift congruent with the structural drift of the environment. This drift will appear to the observer as having been ‘selected’ by the environment throughout the history of interactions of the living being, so long as it is alive.” (Maturana and Varela, *The Tree of Knowledge*, pp.102-103).

[10] A system, such as second-order autopoietic systems, exhibit operational closure in their organisation, when “their identity is specified by a network of dynamic processes whose effects do not leave the network.” (Maturana and Varela, *The Tree of Knowledge*, p.89).

[11] Ibid., p.26.

[12] Ibid.

[13] Ibid., pp.51-52

[14] Alva Noë, *Out of Our Heads : Why You are Not Your Brain, and other Lessons from the Biology of Consciousness* (New York: Hill and Wang, 2009), p.42.

[15] Marx, *Capital Vol.1*, p.283. It is worth noting in general that Marx uses the term ‘Mensch’, which translates as humanity, people etc, not necessarily as ‘man’.

[16] Ibid., p.133.

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[17] David Harvey, *Reading Marx's Capital Lesson 2* video of lesson accessed 1.7.09 from www.davidharvey.org

[18] Marx, *Capital Vol. 1*, pp.133-4.

[19] This seems very important for any attempt to re-conceive of what ecological economists such as Fritz Schumacher have called "natural capital". See E.F. Schumacher, *Small is Beautiful - A Study of Economics as if People Mattered* (London: Abacus, 1974)

[20] Marx attributes this, though not as a direct quotation, to William Petty.

[21] Marx, *Capital Vol.1*, p.283.

[22] Ibid.

[23] Ibid., p.283-4.

[24] Ibid., p.283.

[25] Ibid.

[26] Ibid.

[27] Ibid., p.284. In fact, Marx uses the word 'Baumeister', which is perhaps better translated as 'master-mason' – although there was a modern architectural as well as medieval conception of 'Baumeister' active in German thinking at this time, following for example Schinkel.

[28] Howard L. Parsons (ed.), *Marx and Engels on Ecology* (London: Greenwood Press, 1977), pp. 50-51.

[29] Harvey devotes almost an entire lesson in *Reading Marx's Capital* to this footnote. Foster discusses it in John Bellamy Foster, *Marx's Ecology* (New York: Monthly Review Press, 2000), pp. 196-207. The full footnote from Marx reads: "A critical history of technology would show how little any of the inventions of the eighteenth century are the work of a single individual. As yet such a book does not exist. Darwin has directed attention to the history of natural technology, i.e. the formation of the organs of plants and animals, which serve as the instruments of production for sustaining their life. Does not the history of the productive organs of man in society, of organs that are the material basis of every particular organisation of society, deserve equal attention? And would not such a history be easier to compile since, as Vico says, human history differs from natural history in that we have made the former and not the latter? Technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from these relations. Even a history of religion that is written in abstraction from this material basis is uncritical. It is, in reality, much easier to discover by analysis the earthly kernel of the misty creations of religion than to do the opposite, i.e. to develop from the actual, given relations of life the forms in which these have been apotheosized. The latter method is the only materialist, and therefore the only scientific one. The weaknesses of the abstract materialism of natural science, a materialism which excludes the historical process, are immediately evident from the abstract and ideological conceptions expressed by its spokesmen whenever they venture beyond the bounds of their own speciality." (pp.493-4).

[30] Ibid. "Critical" was an interesting word for Marx to chose, and seems very contemporary today. One wonders whether any of the 'critical histories of technology' that modernity has produced (McLuhan, Kittler, Banham, Giedeon, Luhmann, de Landa, Latour) would satisfy Marx's call.

[31] John Bellamy Foster, "Marx's Ecology in Historical Perspective", in *International Socialism*, Issue 96 (Autumn 2002), accessed 28.2.09 from http://pubs.socialistreviewindex.org.uk/isj96/foster.htm

[32] Marx, *Capital Vol.1*, pp.493-4.

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[33] Marx is particularly referring to, Foster suggests, Chapter 5, on 'Laws of Variation', in Charles Darwin's *The Origin of Species*. Foster goes on to suggest that "the evolution of natural technology … was a reflection of the fact that animals and plants were able to pass on through inheritance organs that had been developed through natural selection in a process that might be called '"accumulation" through inheritance'. Indeed, the driving force of evolution for Darwin, in Marx's interpretation, was 'the gradually accumulated [naturally selected] inventions of living things'." Foster, "Marx's Ecology in Historical Perspective", in *International Socialism*, Issue 96 (Autumn 2002), accessed 28.2.09 from http://pubs.socialistreviewindex.org.uk/isj96/foster.htm

[34] Marx, *Capital Vol.1*, pp.493-4.

[35] It is interesting to consider this comment in the light of Bill Hillier's configurational theory of architecture, which describes how the particular technology of organising space, into buildings and cities, is analogous to acting as the genotype of society. He states that "the observable material world of interaction in which we live is not itself society but it is the means by which society, the abstraction, realises itself in space-time and thus projects itself from past to future." He continues, "buildings are not maps of human interaction. They are maps of the social genotypes of social interaction. This is what makes them so powerful. Social interactions as spatial events are momentary realisations of abstractions, of which they are therefore the phenotypes. Buildings only contingently house the phenotypes of human interaction. The most fundamental error of the paradigm of the machine was to seek order in the relation of people to the built world precisely in these localised phenotypes." Bill Hillier, *Space is the Machine: A Configurational Theory of Architecture* (Cambridge: Cambridge University Press, 1996), pp.402-3.

[36] In so far as the organs of natural technology are used by human technology as a part of the production of human social organs, the history of natural technology becomes part of the history of human technology. And insofar as human technology intervenes in the production of natural technology, it contributes to a part of that history too (along with beavers, etc.).

[37] Marx, *Capital Vol.1*, pp.493-4.

[38] Wright stated of Gurdjieff that "real men who are real forces for an organic culture of the individual today are rare." Frank Lloyd Wright, 'Gurdjeef at Taliesin', *Capitol Times* (Madison, Wisconsin), Sunday, August 26, 1934. Accessed 1.7.08 from http://www.ouspensky.org/wright1.htm

[39] Erich Mendelsohn, lecture at UCLA 1948, cited in Joseph Rykwert, 'Organic and Mechanical', in Braham and Hale with Sadar (eds), *Rethinking Technology*, p.338.

[40] Mies van der Rohe, 'Inaugural Address as Director of Architecture at Armour Institute of Technology', reproduced in Fritz Neumeyer, 'Appendix 3', in *The Artless Word, Mies van der Rohe on The Building Art*
(Cambridge, Mass./London, MIT, 1991), p.317.

[41] See Peter Blundell-Jones, *Hugo Haring: The Organic Versus the Geometric* (Stuttgart; London: Edition Axel Menges, 1999).

[42] Victoria Watson, unpublished 'Notes on Organic', supplied to the author.

[43] Ibid.

[44] For a useful discussion of the role of dynamism in modern architecture generally, see Kari Jormakka, *Flying Dutchman - Motion in Architecture* (Berlin: Birkhäuser, 2002)

[45] Farshid Moussavi 'The Function of Ornament' in Farshid Moussavi and Michael Kubo (eds.), *The Function of Ornament*, (Cambridge: Actar, Harvard School of Design, 2007) p.5.

[46] Kas Oosterhuis, cited in Jormakka, *Flying Dutchman,* p.21.

[47] Humberto Maturana and Francisco Varela, *Autopoiesis and Cognition: The Realization of the Living* (Dordrecht, Holland: D. Reidel Publishing, 1980), p.82.

[48] Manuel de Landa, 'The Non-Linear Development of Cities' in Amerigo Marras (ed.), *Eco-Tec: Architecture of the In-Between* (New York: Princeton Architectural Press, 1999), p. 23.

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[49] Ibid.

[50] Ibid.

[51] As a somewhat complex example, somewhere in the *Whole Earth Catalogue*, Stewart Brand suggests that communism is organic, whilst capitalism is ecological.

[52] Gregory Bateson, as cited in Bateson, 'The Double Bind', p.14.

[53] Joseph Rykwert, 'Organic and Mechanical', p.348.

[54] Reinhold Martin, 'Organicism's Other', in *Grey Room*, no. 04 (Summer 2001), pp.34-51.

[55] Reinhold Martin, *The Organisational Complex: Architecture, Media, and Corporate Space* (Cambridge, MA: MIT Press, 2005), p.3.

[56] A survey of design studios in London architecture schools in the last year or two reveals an extraordinary proliferation of the word 'ecology'. Some of the more exemplary examples might include Michael Hensel, Marcos Cruz et al referring to a series of variations of 'morpho-ecologies', whilst Murray Fraser ran a 'stealth ecology' studio, and only a few years before my colleagues and I ran a succession of studios variously entitled 'pattern ecologies', 'cybernetic ecologies' and the catch-all 'architectural ecologies'! Many of these have been attempts to find a way to develop a conceptual response to the challenges posed by the demands of sustainability and "the environmental question", as it has become increasingly foregrounded as an issue in architectural theory and practice. It is almost impossible to conceive of even the most mundane response to demands for energy efficiency, cyclically managed material flows, and so on, without designing within the context of some kind of systemic conception of forces and flows – and it is to this end that the various architectural tributes to 'ecology' are no doubt offered.

[57] Ernst Haeckel, *General Morphology of Organisms; General Outlines of the Science of Organic Forms based on Mechanical Principles through the Theory of Descent as reformed by Charles Darwin* (Berlin, 1866) Quoted in Frank Benjamin Golley, *A History of the Ecosysytem Concept in Ecology* (New Haven: Yale University Press, 1993), p.207.

[58] Capra, *The Web of Life*, p.34. Capra goes on to say that "by viewing an ecological community as an assemblage of organisms, bound into a functional whole by their mutual relationships, ecologists facilitated the change of focus from organisms to communities and back, applying the same kinds of concepts to different system levels."

[59] "[B]y the mid-1970s other engagements had in fact already expanded the notion of ecology to encompass social and technological systems as well as organic ones. These form an alternative – and more conceptually ambitious – discourse, informed by the development of cybernetics (the interdisciplinary study of regulatory systems, related to systems theory), which emerged in the second half of the twentieth century. Developed in the work of diverse figures such as British anthropologist and social scientist Gregory Bateson, artist-theorist Jack Burnham, Hungarian-born artist and writer György Kepes and visionary architect Richard Buckminster Fuller, 'systems ecology' provides a useful conceptual framework for comprehending the work of artists such as Dan Graham, Robert Barry, Hans Haacke and Les Levine, who were practising in the 60s and early 70s." Demos, 'The Politics of Sustainability', p.23.

[60] Some of geography's complex origins emerge in this period, through the concept of human ecology, which soon became a form of regionalism, that looked at the relationship between physical and social systems. Pepper notes that the French geographers Vidal de la Blache and Jean Brunhes categorised France into a series of distinct cultural regions. As Pepper again notes, this concept, which has much to commend it in many respects, was nonetheless implicated practically from the start with a series of more sinister political ideologies, such as Social Darwinism. Specifically, the conceptualisation of the region as a socio-biological living organism suggested that the national state as a collection of such organisms was itself an organism, and one that was in a 'struggle of the fittest' with other similar states for *lebensraum*.

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61 The extraordinary status of these imperialist companies, which encompassed everything from colonial government to managing both local landscapes and global material flows meant that they consciously confronted a need for systems thinking at the leading edge of capitalist development at the time.

62 Justus von Liebig, as quoted in Foster, *Marx's Ecology*, p.16.

63 Circulation was coined as a concept by the physician William Harvey, in his research on blood flow in the body, in the early seventeenth century. It was, as Adrian Forty has observed, soon adopted into architectural thinking (as circulation through buildings), and later political economy, as in the circulation of money and goods. For a discussion of the conceptual history of circulation and metabolism (in relation to Marxian political ecology) see Eric Swyngedouw, 'Metabolic Urbanisation: The making of Cyborg Cities' in Nik Heynen, Maria Kaika and Eric Swyngedouw (eds), *In the Nature of Cities: Urban Political Ecology and the politics of Urban Metabolism* (London: Routledge, 2006), pp.25-33.

Adam Smith of course saw the free-market economy as akin to an organism – a spectral organism whose "invisible hand' would emerge as a higher level of rational organisation. However, we now know all too well that the teleological 'attractors' that the market sets itself (which are emergent out of present activity, but located in the relational space time of the future) are not necessarily those that are in the interest of other organisms, whether social or natural.

64 Haeckel, *General Morphology of Organisms*, as quoted in Golley, *A History of the Ecosysytem Concept in Ecology*, p.207.

65 Ecosystem was first coined by Roy Clapham in 1930, although its modern sense derives from Arthur Tansley (1935). Tansley replaced Frederic Clements' (an American plant ecologist) concept of 'super-organism' with 'ecosystem', which he defined as "a community of organisms and their physical environment interacting as an ecological unit." The term biosphere was introduced by Austrian geologist Eduard Suess in 1875 to describe the layer of life surrounding the earth. The term 'biosphere' was however popularised and given its full current meaning – the ecosystem of ecosystems – by the Russian geochemist Vladimir Vernadsky. In 1926, Vernadsky – synthesising Goethe, Humboldt, and Suess, and anticipating Margulis and Lovelock – described the biosphere, and the life of which it was composed, as a 'geological force.' He was among the first to realise the full extent that life had shaped the planet geologically and compositionally, and anticipated much that James Lovelock would later describe in Gaia theory. For Vernadsky, the biosphere was not only a description of the site of life on Earth, it also classified an historical epoch in the planet's development. The biosphere was the second stage in the evolution of the planet. The first stage he called the geosphere, and this described the planet before life (and of which there are of course substantial remaining legacies in non-organic rocks, mantel, core, etc.). The third stage, which he termed noosphere, was the stage of human mind. For Vernadsky, just as the biosphere transformed the geosphere, the noosphere is transforming the biosphere. Variations of Vernadsky's concept of noosphere include the sense of an emergent collective consciousness by Pierre Teilhard de Chardin – a variation of which is being researched by the Princeton Global Consciousness Project, which is based upon the fact that random number generators appear to become less random during major global media events, such as Princess Diana's death, and the 9-11 attack on New York's World Trade Centre (see http://noosphere.princeton.edu/)! accessed 1.1.09).

66 David Pepper, *The Roots of Modern Environmentalism* (London: Croom Helm, 1984), pp.103-04.

67 See for example Howard T. Odum, 'Energy, Ecology and Economics', *Ambio*, vol. 2 no.6, 1973, pp. 220-27.

68 Eugene Odum, as cited in Pepper, *Modern Environmentalism*, pp.283-84.

69 Gerald G. Marten, *Human Ecology: Basic Concepts for Sustainable Development* (London: Earthscan, 2001).

70 See Howard T. Odum, *Ecological and General Systems: An Introduction to Systems Ecology* (Colorado: Colorado University Press, 1994).

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[71] Of course, this is not to imagine a ‘pure’ informational system on top of an energetic system, but is rather a description of how in networks of interdependent energetic and material circuits (such as an ecosystem), some flows will act *in informational ways* with respect to other circuits, changing other flows (which themselves might then act in informational ways elsewhere etc). Bateson notes for example that “in life and its affairs there are normally two energetic systems in interdependence: one is the system of that uses its energy to open or close a faucet or gate or relay; the other is the system whose energy flows through the gate when open”. Gregory Bateson, *Mind and Nature: A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002), p.95.

[72] Gregory Bateson and Mary Catherine Bateson, *Angels Fear: Towards an Epistemology of the Sacred* (Cresskill, NJ: Hampton Press, 2005) p.207-08.

[73] Peter Harries-Jones, *A Recursive Vision: Ecological Understanding and Gregory Bateson* (Toronto: University of Toronto Press, 1995), p.7.

[74] Sponsored by the Wenner-Gren Foundation, a consistent supporter of Bateson’s projects. They had also supported his 1968 and 1969 conferences on conscious purpose and human adaptation, which were held in Austria.

[75] Gregory Bateson, ‘Restructuring the Ecology of a Great City’ in *Radical Software*, Vol 1 Issue 3, Spring 1971 (accessed from http://www.radicalsoftware.org/e/volume1nr3_pics.html). The journal *Radical Software* had been conceived by Paul Ryan as a vehicle for pushing Bateson’s ideas in media studies, and in the main editorial Beryl Korot and Michael Shamberg stated that “Others have detailed the need for whole alternate economic support systems, but they have neglected media. Our feeling is that unless there's an alternate media as well, not just alternate content played over the existing structures, a lot of very positive energy may end up as just content for the existing context. Our contribution, we hope, will be in suggesting some (but not all) directions an information economy might take.”

[76] Bateson substantially reworks the original paper in the *Steps* version. In the original Bateson feels the need to reference some “specialists” in urbanism, and so the paper contains references to Christopher Alexander and Richard Sennett (*Notes on the Syntheses of Form* by Christopher Alexander, (Cambridge, MA: Harvard University Press, 1964) and *The Uses of Disorder: Personality and City Life* by Richard Sennett (New York: Knopf, 1970). These are removed from the final version. At the Wenner Gren conference organised by Bateson and Mead in 1968, entitled “Effects of Conscious Purpose on Human Adaptation,” the cybernetician Gordon Pask had made key contributions in his paper interpreting the work of Christopher Alexander. This is likely to have been Bateson’s introduction to Alexander’s work.

[77] Mark Wigley, ‘Recycling Recycling’ in Amerigo Marras (ed.), *Eco-Tec: Architecture of the In-Between* (New York: Princeton Architectural Press, 1999), p.42.

[78] David Cunningham, ‘The Concept of Metropolis: Philosophy and Urban Form’ in *Radical Philosophy* no.133 September/October 2005, p.13.

[79] Ibid., p.20.

[80] Ibid., p.18.

[81] Following Bateson, I suggest that we should consider the pattern-form of the metropolis as an ecology of mental characteristics. In fact, I would argue that if we re-translate from German the quote from Karl Scheffler in Cunningham’s piece, this time interpreting Geist as mind rather than spirit, we are told that “what is absolutely decisive for the concept of the modern metropolis is not the number of its inhabitants but rather the mind of the metropolis [*Grossstadt Geist*].” Schffler as cited in David Frisby, *Cityscapes of Modernity*, (Cambridge: Polity Press, 2001), p.266.

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[82] I suggest that an ecological conception of metropolis can properly describe what Cunningham describes as “transformations within the relations between urban and rural, as well as, with increasing importance, within and between different urban forms and processes of urbanization and the heterogenous forces which generate them. The potential generalization of social, cultural and technological productive logics at a planetary scale, and the ‘concrete’ networks of exchange and interaction that increasingly bind non-contiguous urban spaces together within the differential unity of a global economy, open up a historically new set of relations between universal and particular, concentration and dispersal, that clearly demand new conceptions of mediation.” Cunningham, ‘The Concept of Metropolis: Philosophy and Urban Form’, p.13.

[83] David Harvey, ‘The Right to the City’ (David Harvey responding to the *Ecotopedia enquete* via e-mail from New York City, USA, on 6th August 2008.), accessed at http://sustainablecities.dk/en/actions/interviews/david-harvey-the-right-to-the-city

[84] Mark Wigley, ‘Recycling Recycling’, p.48.

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[1] Albert Einstein, quoted in M. Capek, *The Philosophical Impact of Contemporary Physics* (Princeton, NJ: D van Nostrand, 1961), p.319 – as cited in Fritjof Capra, *The Tao of Physics: A Study of the Parallels between Modern Physics and Eastern Mysticism* (London: Flamingo, 1991), p.233.

[2] Erwin Schrödinger, 1967, cited at http://open-site.org/Science/Physics/Modern/Quantum_Mechanics, accessed 1.8.09. This widely cited quotation was actually written in precisely this English/German hybrid form by Schrödinger. Most people assume that *Schaumkommen* translates as appearances, but it does not. Schaumkommen translates as "foamy, bubbling up", or something like that. He is trying to describe the process by which particles bubble up out of the spacetime field.

[3] In fact, although it seems fairly self-evident once pointed out, I have not been able to find anyone else who has made this observation regarding the gendered opposition of pattern and matter.

[4] Susannah Hagan, *Taking Shape: A New Contract between Architecture and Nature* (Oxford: Architectural Press, 2001), p.19.

[5] Katie Lloyd Thomas, 'Introduction: Architecture and Material Practice', in Katie Lloyd Thomas (ed.), *Material Matters: Architecture and Material Practice* (London: Routledge, 2007), p.2.

[6] To summarise, there are a series of binary oppositions based upon the "form/pattern" and "matter" pairing. These oppositions characterise much architectural and design thinking, but can also be found operating deep within our culture. Typically, one side of the binary is dominant, and this is normally the pattern/form side. This is perhaps not surprising, given that this side is "male". But what are we then to make of the materialism of the modern natural sciences? Surely this is an example of "matter" dominating "pattern"? To be sure, repeatedly in modern science an approach which has prioritised a reductive attitude to, and definition of, matter has meant that a more holistic grasp of larger patterns of organisation has often not been noticed. However, rather than this being some victory of the female, it might equally be seen as a patriarchal society's ultimate confrontation between masculine thinking and matter, a final attempt to define matter in such a way that it is stripped of life and relationship?

There are clearly limits to the usefulness of thinking pattern/matter in straightforwardly gendered terms - or at least, it entails further complexities beyond the scope of this chapter – and it is the case that, for example, decoration and ornament, whilst apparently related to pattern, are certainly coded as female

[7] Bernard Pattern, cited in Fritjof Capra, *The Web of Life - A New Synthesis of Mind and Matter* (London: Flamingo 1996), p.35.

[8] Arne Naess, *Ecology, Community and Lifestyle* (Cambridge: Cambridge University Press, 1989), p.49.

[9] According to the Online Etymological Dictionary (www.etymonline.com), "sense of 'interconnected group of people' is from 1947. The verb, in ref. to computers, is from 1972; in ref. to persons, it is attested from 1980s." It is interesting to note that there are only three uses of 'network' in Marx's *Capital*. Firstly on page 207 - "the exchange of commodities breaks through all the individual and local limitations of the direct exchange of products, and develops the metabolic process of human labour. On the other hand there develops a whole network of social connections of natural origin..." – then on page 390 – "the all-embracing network of French legislation" – and on page 1056 again – a "network of social relations."

[10] Capra, *The Web of Life,* p.34.

[11] Mark Buchanan, *Ubiquity* (London: Phoenix, 2001) p.14.

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[12] Ibid., p.36. Capra suggests that there are four key components of systems thinking:
1. Shift from parts to whole - "living systems are integrated wholes whose parts cannot be reduced to those of smaller parts. Their 'systemic' properties are properties of the whole"
2. The systemic properties of the whole emerge from the 'organising relations' of the parts
3. Systems nest within systems, with typically different levels of behaviour at different scales of system
4. Shift in focus from objects to relationships, from matter to pattern - "objects themselves are networks of relationships".

[13] Interestingly for my discussion in chapters Five and Seven, Bertalanffy discussed empathy as a theory of mind. See Ludwig von Bertalanffy (Paul A. LaViolette (ed.)), *A Systems View of Man*, (Boulder, Colorado: Westview Press, 1981), pp.97-100.

[14] This states that systems tend towards increasing homogeneous disorder, in that energy ultimately becomes dissipated heat and 'less useful', and that the universe will ultimately settle into a cold soup. It has an important statistical/probabilistic dimension, given that a highly ordered state is unlikely to reoccur by chance.

[15] Ludwig von Bertalanffy, *General Systems Theory: Foundations, Development, Applications* (New York: Braziller, 1968), p.121.

[16] ibid., p.84.

[17] ibid., p.37.

[18] This obviously parallels critiques of Structuralism in anthropology or literary studies.

[19] Francis Heylighen, 'Cybernetics and Second-Order Cybernetics' in R.A. Meyers (ed.), *Encyclopedia of Physical Science & Technology* (3rd ed.) (New York: Academic Press, 2001), p.3.

[20] Others – for example Joël de Rosnay – have argued that both cybernetics and General Systems Theory are best considered as parts of what he calls a "systemic approach". He states that "we need to locate the systemic approach with respect to other approaches with which it is often confused. The systemic approach embraces and goes beyond the cybernetics approach (N. Wiener, 1948), whose main objective is the study of control in living organisms and machines. It must be distinguished from General Systems Theory (L. von Bertalanffy, 1954), whose purpose is to describe in mathematical language the totality of systems found in nature. It turns away from systems analysis, a method that represents only one tool of the systemic approach. Taken alone, it leads to the reduction of a system to its components and its elementary interactions. The systemic approach has nothing to do with a systematic approach that confronts a problem or sets up a series of actions in sequential manner." Joël de Rosnay, *The Macroscope* (New York: Harper & Row, 1979). Accessed 1.7.09 at http://pespmc1.vub.ac.be/macroscope/chap2.html

[21] Ludwig von Bertalanffy, *Organismic Psychology and Systems Theory* (Worchester: Clark University Press, 1968), pp.17-23.

[22] Gordon Pask's differences of eternal interacting actor loops (that produce finite products). See for example Gordon Pask and Gerard de Zeeuw, *Interactions of Actors, Theory and some applications*, written in 1992, available online at http://www.cybsoc.org/PasksIAT.PDF

[23] Andrei Martin (a current studio tutor and researcher in the Department of Architecture at the University of Westminster), has in conversation suggested that this was one of the conclusions of a Rem Koolhaas-led research programme which Martin contributed to at Harvard in 2000/1. This as yet unpublished research project explored early cybernetic practices in Soviet Architecture. The previous two Harvard research projects, which were on Shopping and the Pearl River Delta, China, have of course since been published.

[24] See G. Gorelik, 'Reemergence of Bogdanov's Tektology' in "Soviet Studies of Organization", *Academy of Management Journal* (1975) 18.2, pp.345–57.

[25] Tektology comes from the Greek *Tekton* meaning 'builder'. Tektology then is the science of structures.

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[26] This is possible, as it was translated into German and published in 1928. At any rate, whilst there is no doubt as to Bertalanffy's substantial contribution to systems theory, Fritjof Capra has noted that it is certainly "surprising" that he makes no reference to Bogdanov, given the general breadth of Bertalanffy's scholarship.

Bogdanov was an interesting character. A founding member of the Bolshevik party, after the 1905 revolution he led a faction against Lenin, the "recallists". He was a trained and practising medical doctor. He wrote some popular early science fiction, for instance *Red Star: The First Bolshevik Utopia*, published in 1908.

In 1918 Bogdanov founded the Proletkult movement, which was initially supported by the Bolshevik government, although it later fell out of favour. His broader medical research continued throughout this period, and he notably invented the modern blood transfusion process. In fact, he believed that blood transfusion was a route to longer health for everyone. Lenin's sister, Maria Ulianova, was one of Bogdanov's experimental transfusion patients. In 1928 it was ultimately following a blood transfusion experiment on himself that he died (the donor had malaria). However, there has been speculation that this was in fact a suicide, following increasing political harassment as Stalin's purge of all old Bolsheviks picked up speed.

[27] He was a professor at the University of Moscow, and remained a practising medic.

[28] N Katherine Hayles, *How we became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (Chicago: University of Chicago, 1999), p.8.

[29] Francis Heylighen, 'Cybernetics and Second-Order Cybernetics', p.2

[30] This term describes what it sees as an emergent condition of the species as being wholly dependent on and defined by socio-biological technologies: a body and mind extended via the prosthetics of our tools, systems, technologies and networks into a second nature of our own making. The paradox of this position (as I discuss further in Chapter Six) is that, according to this reading, the human must always be considered always already post human, as the human mind is practically organised to align and map itself onto its surrounding space, tools and other 'affordances', in precisely the same way that it maps its own body.

[31] W. Ross Ashby, *An Introduction to Cybernetics* (London: Chapman and Hall, 1956), p.1.

[32] Gordon Pask as quoted by Ranulph Glanville, lecture at University of Greenwich, 27th January, 2009.

[33] Ashby, *An Introduction to Cybernetics*, p.2.

[34] Stuart Umpleby, 'Noted Contributors to Cybernetics and Systems Theory' 1982, revised 2000. Accessed: http://www.asc-cybernetics.org/foundations/cyberneticians.htm

[35] Ashby, *An Introduction to Cybernetics*, p.1.

[36] Both Maturana and von Foerster as cited from http://www.gwu.edu/~asc/cyber_definition.html accessed 1.6.08.

[37] Gregory Bateson, 'From Versailles to Cybernetics' in *Steps to an Ecology of Mind* (Chicago: University of Chicago Press, 2000), p.484.

[38] Ranulph Glanville has lamented that Marvin Minski took all of the research money associated with cybernetic research. Lecture at University of Greenwich, 27th January, 2009.

[39] Francisco Varela put it neatly when he stated: "First order cybernetics: The cybernetics of observed systems. Second order cybernetics: The cybernetics of observing systems." Francisco Varela, 'Introduction' in Heinz von Foerster, *Observing Systems : Selected papers by Heinz von Foerster, Edited by F.Varela*, (Santa Barbara, CA: Intersystems Publications, 1982), p.xi.

[40] Margaret Mead, 'Cybernetics of Cybernetics' in H. Von Foerster, J.D. White, L.J. Peterson, and J.K. Russell (eds), *Purposive Systems*, (New York, Spartan Books: 1968), pp.1-19.

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[41] Constructivist thinking in this sense has nothing to do with the early-twentieth century European art and architectural movement of the same name. Nor should it be confused with the mathematical constructivism of for example set theory. It should also be differentiated from other sociological and philosophical constructivisms (although there is much that is shared also). Radical Constructivism was first coined by von Foerster, and was based in his and Bateson's thinking. It was further developed by Ernst von Glasersfeld, and is the philosophical position that sits behind the strain of cybernetic thinking that has most directly fed into certain schools of architecture in recent years through figures such as Ranulph Glanville and Stephen Gage. This states that the observer is active, in all kinds of ways, in constructing the world that they experience and interface with. The constructivist position – that I cannot know what the world is without me – is quite distinct from a solipsist position, which says that the world is in me. It does not in anyway doubt the existence of an external reality – it is just that we do not experience the full blast of what is there, but rather "bring forth" into our construction those aspects of reality that we can engage with in some way. Radical constructivists do not see this as a passive activity, but rather emphasise that there are degrees of freedom and choice in what is constructed. Indeed, radical constructivism reminds us that there is a politics to the internal as well as external worlds that we construct. As von Glasersfeld states, "I have reiterated many times, radical constructivism does not suggest that we can construct anything we like, but it does claim that within the constraints that limit our construction there is room for an infinity of alternatives. It therefore does not seem untimely to suggest a theory of knowing that draws attention to the knower's responsibility for what the knower constructs." Ernst von Glasersfeld, 'An exposition of constructivism: why some like it radical', in G.J. Klir (ed.), *Facets of Systems Science* (New York: Plenum Press, 1991), pp. 229-38. Maturana and Varela also emphasise that in *western* culture (remembering here that Varela, like many other cyberneticians, was impressed with Buddhist methods of observing the processes of mind) we can be particularly unaware of the way that we construct our experience of the external world. They note that "this special situation of knowing how we know is traditionally elusive for western culture. We are keyed to action not reflection, so that our personal life is generally blind to itself. It is as though a taboo tells us: 'it is forbidden to know about knowing'. Actually, not knowing what makes up this world of experience, which is the closest world to us, is a crying shame. There are many things to be ashamed of in the world, but this ignorance is one of the worst." Humberto R. Maturana, and Fransisco J. Varela, *The Tree of Knowledge: The Biological Roots of Human Understanding* (Boston: Shambhala Publications, 1987), p.24.

[42] Katherine Hayles also describes a third wave of cybernetics – although drawing a slightly different distinction. Hayles argues that "just as Heinz von Foerster served as the transition figure between the first and second waves, so Francisco Varela bridges the transition between the second and third waves." (Hayles, *How we became Posthuman,* p.222.) For Hayles, the distinction between second-wave and third-wave cybernetics is "getting the system to evolve in new directions" – which means for Hayles that "in contrast to the circular processes of Humberto Maturana's autopoiesis, the figure most apt to describe the third wave is a spiral" (Ibid., p.222). This is, to be sure, an important distinction. However, it is one that most commentators would I think place at the boundary of first-order and second-order, or perhaps better still, at the boundary of radical and conservative cybernetics. In other places, Hayles makes a slightly different distinction again, suggesting that the three waves characterise three distinct historical "interplays between embodied forms of subjectivity and arguments for disembodiment." (Ibid., p.7.) She suggest that "the first, from 1945-1960, took homeostasis as the central concept; the second, going roughly from 1960-1980, revolved around reflexivity; and the third, stretching from 1980 to the present, highlights virtuality." (Ibid., p.7.)

[43] See Jasia Reichardt (ed), *Cybernetic Serendipity - the computer and the arts*, (London: Studio International Special Issue, 1968)

[44] Bruce Clark and Mark B.N.Hansen (eds.), *Emergence and Embodiment - New Essays in Second-Order Systems Theory* (Durham and London: Duke University Press, 2009), pp.5-6.

[45] These would, for different reasons, include the likes of Buckminster Fuller, Frederick Keisler, Cedric Price, John Fraser, Gordon Pask, Ranulph Glanville, Christopher Alexander, Archigram, Reyner Banham, Stephen Gage, Pete Silver, Will McClean, Bill Hillier, and many others. (One might include Koolhaas' OMA/AMO - certainly in so far as they have tried to position themselves as a systems consultancy at a certain scale of systems management and branding).

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[46] Andrew Pickering, *The Cybernetic Brain - Sketches of Another Future* (Chicago and London: University of Chicago Press, 2010), p.31.

[47] Ibid., p.30.

[48] The core group who attended the initial event in March 1946 was made up of Gregory Bateson (anthropologist), Julian Bigelow (computer engineer-inventor), Gerhardt von Bonin (neuroanatomy), Lawrence Frank (social science), Frank Fremont-Smith (medicine / Macy Foundation representative), Ralph W. Gerard (neurophysiology), Molly Harrower (psychologist), George Evelyn Hutchinson (ecology), Heinrich Klüver (psychology), Lawrence Kubie (psychiatrist), Paul Lazarsfeld (sociology), Kurt Lewin (psychology), Rafael Lorente de Nó (neurophysiology), Warren McCulloch (neuropsychiatry, Chair), Margaret Mead (anthropologist), John von Neumann (mathematics), Filmer S. C. Northrop (philosophy), Walter Pitts (mathematics), Arturo Rosenblueth (physiology), Leonard J. Savage (mathematics), and Norbert Wiener (mathematics). In the meetings that followed other members joined the core group, plus a regular stream of invited guests. Most notably, Heinz von Foerster attended from the sixth conference in March 1949, and at Margaret Mead's suggestion, he thereafter produced a transcription of the proceedings – partly as a way to improve his English. It is perhaps worth noting that apart from the proceedings transcriber, Mrs Freud, Mead was the only female present. Also, all participants were of course white and western.

[49] Ranulph Glanville has remarked that "communication and control" is often mistaken for a definition, but it is just a subtitle. He goes on to add that Weiner's second book, *The Human use of Human Beings*, should have been published first, and is a much better introduction to the big ideas. For Glanville, the most important figures in the Macy conferences were "McCulloch, Mead and Bateson."

[50] Claude Shannon in a letter to Norbert Wiener in the 1940's: "Use the word `cybernetics', Norbert, because nobody knows what it means. This will always put you at an advantage in arguments." as cited at http://www.asc-cybernetics.org/foundations/definitions.htm accessed 1.8.08

[51] According to Edward A. Shanken, 'Cybernetics and Art: Cultural Convergence in the 1960s', in Bruce Clark and Linda Dairymple Henderson (eds), *From Energy to Information: Representation in Science and Technology, Art and Literature* (Stanford: Stanford University Press, 2002), p.257.

[52] Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, 'Behaviour, Purpose and Teleology,' *Philosophy of Science* Vol. 10 (1943). pp. 18-24

[53] Stewart Brand, Gregory Bateson and Margaret Mead (in conversation), 'For God's Sake, Margaret' in *CoEvolutionary Quarterly* 10 (June 1976), pp.32-44. Accessed online 1.7.08 at http://www.oikos.org/forgod.htm

[54] Ibid.

[55] According to Stewart Brand, the twenty participants of the 1942 Cerebral Intuition conference "included representatives of anthropology, psychobiology, physiology, psychiatry, neurology, psychology, medicine, anatomy and electronics. Among those present were Gregory Bateson, Lawrence K. Frank, Frank Fremont-Smith, Lawrence Kubie, Warren McCulloch, Margaret Mead, Arthur Rosenblueth." Brand, in Brand, Bateson and Mead 'For God's Sake, Margaret'

[56] Mead, in Brand, Bateson and Mead 'For God's Sake, Margaret'

[57] From a letter sent to publisher as a part of biography for a book proposal called *The Evolutionary Idea* (the manuscript of which Bateson superseded with *Mind and Nature*), in John Brockman (ed.) *About Bateson* (London: Wildwood House, 1977), p.10.

[58] Mead, in Brand, Bateson and Mead 'For God's Sake, Margaret'

[59] Gregory Bateson, 'Preface' to the *Naven: A Survey of the Problems suggested by a Composite Picture of the Culture of a New Guinea Tribe drawn from Three Points of View*. Second Edition (Stanford: Stanford U P, 1958), p. viii.

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[60] Margaret Boden, ‘Grey Walter’s Anticipatory Tortoises’ in *The Rutherford Journal*. Accessed online 1.8.08 at http://www.rutherfordjournal.org/article020101.html

[61] In a letter to Grey Walter of 27th July 1949, John Bates suggested forming a club of “people who had Weiner’s ideas before Weiner’s book appeared”, this letter was transcribed in Philip Husbands and Owen Holland, ‘The Ratio Club - A Hub of British Cybernetics’, in Phil Husbands, Michael Wheeler, Owen Holland (eds.), *The Mechanical Mind in History* (Cambridge, MA and London: MIT Press, 2008), pp.91-148.

[62] The practical bent of the English cognitive-cybernetic research has continued to this day, with situated robotics providing the key research knowledge that Andy Clark has built his Extended Mind thesis upon – although Clark makes surprisingly little reference to the historical extended mind thinking in much cybernetic theory, and refers almost exclusively to contemporary theorists and experimentalists.

[63] ELSIE: Electro-mechanical robot, Light-Sensitive with Internal and External stability, and ELMER: ELectro-MEchanical Robot.

[64] P.T. Saunders (ed), *Collected Works of Alan Turing: Morphogenesis* (London: North-Holland, 1992).

[65] Feedback is arguably the most important concept to have emerged in the first wave of cybernetic research, and it describes the way that information moves around a circuit (whether organic or mechanical.) Feedback is a key element in understanding homeostasis. Capra notes that “the concept of the feedback loop introduced by the cyberneticists led to new perceptions of the many self-regulatory processes characteristic of life. Today we understand that feedback loops are ubiquitous in the living world, because they are a special feature of the nonlinear network patterns that are characteristic of living systems.” Capra, *The Web of Life*, pp.58-59.

[66] Their discussion around these two terms was primarily concerned with whether the brain should be considered as analogic or digital. Long before digital became exclusively associated with silicon chip based computer processors, digital meant an on/off switch. Analogue referred by contrast to “those that vary continuously and in step with magnitudes in the trigger event.” (Bateson) One might say that digital refers to absolute states in a relative space-time, whereas analogue is more dependent upon a relational spacetime. For a discussion see Gregory Bateson, ‘Criteria of Mental Process’ in *Mind and Nature: A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002), p.103-04.

[67] Bateson emphasises that what he calls “the holistic and mental character of the system” is most clearly demonstrated by the fact that it is a historical system, it incorporates time into the functioning of its mental circuitry. He states that “message material (ie successive transforms of difference) must pass around the total circuit, and the time required for the message to return to the place from which it started is a basic characteristic of the total system ... it is thus in some degree determined not only by its immediate past, but by what it did at a time which precedes the present by the interval necessary for the message to complete the circuit. There is thus a sort of determinative memory in even the simplest circuit.” Ibid., p.100.

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[68] The cybernetic conceptual tool of the *Black Box* goes back to James Clark Maxwell's experiments with electro-magnetic fields. He defined *Maxwell's Daemon* (the first black box) as a conceptual clarification device in his Theory of Heat. Its conceptual use in cybernetics can be traced more directly as an abstraction of a real test that is used electrical engineering study. A student is given box with inputs and outputs, and by using various tests, must ascertain what component is inside. This of course has many real life applications as well (from bomb sites to ICT systems to particle colliders) where a system can't be dismantled. In fact, the black box concept is widely used to discuss systems with both known and unknown unknowns. Beyond that, as Ross Ashby reminds us "in our daily lives we are confronted at every turn with systems whose internal mechanisms are not fully open to inspection, and which must be treated by the methods appropriate to the black box." Ashby, A*n Introduction to Cybernetics*, p.86. Assuming the experimenter has certain resources for acting (e.g. prod it, shine light, etc) and observing (photo, record temp, etc), Ashby states that there are three questions to ask:

1. how should experimenter proceed?
2. what properties are discoverable, what are fundamentally not?
3. what methods should be used?

Ashby notes – in a formulation that makes clear the early emergence of second-order reflexive thinking – that "by acting on the Box, and by allowing the Box to affect him and his recording apparatus, the experimenter is *coupling* himself to the Box, so that the two together form a system with feedback: [box] [double arrow][experimenter]" op. cit. That is to say, we study our *relation* to the black box, not the black box itself.

In fact, as Glanville has noted, humans can hop between two observing positions – one immersed in circuit, and the other in a 'higher level' observing circuit. This fundamental formation of cybernetics is very similar to holding a dialectical position, and it seems clear to me that the spacetime relationality of cybernetic theory is very evident here. Although I cannot pursue this line of thought any further here, I think this does nonetheless suggest a site of convergence for a meeting between a dialectical Marxian mode of thought, based upon an internal relations based conception of spacetime, and second-order cybernetics.

[69] Information is pattern: literally that which gives form to, or informs, matter. One rigourous definition of information was produced by Claude Shannon, key to which is the concept of negentropy (see next footnote). For Bateson "[A]ny ongoing ensemble of events and objects which has the appropriate complexity of causal circuits and the appropriate energy relations will surely show mental characteristics. It will compare, that is, be responsive to difference (in addition to being affected by the ordinary physical 'causes such as impact or force.) It will 'process information' and will inevitably be self-corrective towards homeostatic optima or towards the maximalisation of certain variables... A 'bit' of information is definable as a difference which makes a difference. Such a difference, as it travels and undergoes successive transformation in a circuit, is an elementary idea..." Bateson, 'The Cybernetics of Self: A Theory of Alcoholism', in *Steps to an Ecology of Mind*, p.315.

[70] Negentropy is negative entropy. Just as entropy is defined (as the second law of thermodynamics) as the tendency of things to become homogenous and disordered, negentropy defines the negative condition of this, or order in a system. Negentropy is a key concept in understanding how living systems (and indeed some 'near to living' systems, such as Prigogine's dissipative structures) reverse entropy and bring organisation to matter. Both Weiner and Shannon realised that there was more broadly a relationship between information and the laws of thermodynamics. Weiner coined the term negentropy, and the concept is key to Claude Shannon's theory of information. Here, negentropy describes the amount of order or information in a noisy signal.

[71] "[T]he most fundamental concept in cybernetics is that of 'difference', either that two things are recognisably different, or that one thing has changed with time." Ashby, *An Introduction to Cybernetics*, p.9.

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[72] Homeostasis is for Hayles the primary idea of the first wave of cybernetic research. The concept first emerged in the work of French physiologist Claude Bernard, and his concept of the *milieu interieur,* in the late nineteenth century. Bernard was particularly attentive to the coupling of the organism to its environment, and realised that organisms create stable internal environments, in which they ‘live’ and are protected from variable external environments, and through which they produce themselves as organisms. He stated that “The constancy of the internal environment is the condition for a free and independent life," and that this “constancy” is homeostasis: the ability of a system to maintain its internal conditions of existence (homeorhesis is the ability of a system to maintain a stable trajectory.) Homeostasis was developed further by Walter Cannon, initially in his book *The Wisdom of the Body* (1932). As developed by cybernetics, homeostasis is dependent upon feedback. Specifically cybernetics shows how through combinations of positive and negative feedback a system can maintain a steady state, even whilst inputs from and outputs to an external environment vary. Sweating is a simple example of a homeostatic response to rising external temperature.

[73] The Law of Requisite Variety was discovered and formulated by Ross Ashby. It shows that for any one system to control another, it must have at least as many potential states if it is not to be a ‘dictator’. Of course, systems can self-control, but this is specifically looking at two systems. This Law can have interesting applications. If we consider the capitalism/nature opposition, we can ask, will capitalism ever have more states than the natural world? The answer is always no. This is actually practically the case in the straightforward opposition (i.e. if one compares the complexity of the global ecosystem with that of the global economy), but is also logically inevitable in the universal sense of nature, as ultimately capitalism is a part of nature (even though from inside capitalism it appears that nature is produced by capitalism.) This means that according to the Law of Requisite Variety, capitalism can never successfully dominate nature without ‘dictatorship’.

[74] In particular, it might be argued that G. Spencer-Brown’s *Laws of Form* might be thought of as a cybernetic attempt to formulate from first principles a recursive account of relational spacetime.

[75] J. Y. Lettvin, H. R. Maturana, W. S. McCulloch, and W. H. Pitts, ‘What the Frog’s eye tells the Frog’s Brain’, in William C. Corning and Martin Balaban (eds.), *The Mind: Biological Approaches to its Functions* (New York : Interscience Publishers, 1968) pp.233-58. To get a glimpse of the politics of cybernetics research funding, this paper states in a note that the research was supported in part by the U.S. Army (Signal Corps), the U.S. Air Force (Office of Sci. Res., Air Res. and Dev. Command), and the U.S. Navy (Office of Naval Res.), and in part by Bell Telephone Labs, Inc., and the Research Laboratory of Electronics, Massachusetts Institute of Technology.

[76] A real abstraction for Marx describes the condition of a ‘conceptual’ or virtual abstraction become real or actual. For Marx in *Capital*, this is how money is conceptualised (and practiced of course). Lefebvre develops a distinct concept of ‘concrete abstraction’, which he uses to describe urban form. David Cunningham works with differences between these two abstractions as a means of producing “a concept of metropolis” (see ‘The Concept of Metropolis: Philosophy and Urban Form’, in *Radical Philosophy 133* (2005)pp. 13-24). It seems to me that for Bateson (reading him as a Hegelian Ecologist perhaps), the entire biological world can only be understood as systems that *really* work with abstraction, and in which processes of value creation and communication are ubiquitous. There does appear to be a concrete sense in which biological systems (and perhaps all material processes) do unfold through and together with the production of what Lefebvre describes as the “‘pure’ forms [of].. identity and difference, equivalence, consistency, reciprocity, recurrence, and repetition”. (Henri Lefebvre, *The Production of Space* (Oxford: Blackwell, 1991) p.100.) Given that, it seems to me that there might be useful work to do, exploring the specific biosemiotic conception of Bateson (plus that of with Varela) through Marxian conceptions of real and concrete abstraction.

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[77] This is doubly worth noting as there is much useful criticism of some schools of philosophy of mind which have been accused of imagining that the brain is a computer. Without wanting to underplay the often useful nature of these critiques it is worth noting that in fact the computer was modelled on animal neural networks. There is a concern that some models of mind are actually based on the metaphor of the computer, not the reality of the brain-in-body-in-organonic environments. However, the computer itself really does exist as an abstract model of the human brain, and it is not *entirely* inappropriate to use it in this way. There is only a problem if this model is imagined to provide a complete description of mind, which it cannot.

It is also worth noting that the digital computer was not the only computer imagined by cybernetic research. Gordon Pask and Stafford Beer in particular, imagined and experimented with very different biological and physical computing models, and Andrew Pickering has noted that had they had the same funding as the American miltary-industrial establishment gave von Neumann, then a very different histroy of computing may have arose (Pickering in interview with Neil Baker February 2010, accessed 15.1.11 from http://vimeo.com/10929373).

[78] Hayles, *How we became Posthuman*, p.7.

[79] Ibid., p.2.

[80] Norbert Wiener, *Cybernetics. or Control and Communication in the Animal and Machine* (Cambridge, MA: MIT Press, 1948), p.132.

[81] Bateson states, for example: “The problem is to change the rules, and insofar as we let our cybernetic inventions—the computers—lead us into more and more rigid situations, we shall in fact be maltreating and abusing the first hopeful advance since 1918.

And, of course, there are other dangers latent in cybernetics and many of these are still unidentified. We do not know, for example, what effects may follow from the computerization of all government dossiers.

But this much is sure, that there is also latent in cybernetics the means of achieving a new and perhaps more human outlook, a means of changing our philosophy of control and a means of seeing our own follies in wider perspective.”

Gregory Bateson, ‘From Versailles to Cybernetics’ lecture given April 21, 1966, to the “Two Worlds Symposium” at Sacramento State College, in Bateson, *Steps to an Ecology of Mind*, p.336.

[82] Hayles, *How we became Posthuman*, p.14.

[83] See Pickering, *The Cybernetic Brain.*

[84] Although for Pickering this is by no means a complete mapping. Indeed, he has commented that in many respects second-order cybernetics ended up going in the wrong direction: “think of the tedious stuff that von Foerster produces at the end of his career.” Pickering in conversation with author, 24th February 2010 at “Cybernetics: From the ontological theatre to the environmental crisis” symposium hosted by The Science Technology Culture Research Group at the University of Nottingham.

[85] The panel discussion was convened for the opening of Marcel Duchamp’s (and his brothers) exhibition of the same name.

[86] For a discussion of this panel, see William Kaizen, ‘Steps to an Ecology of Communication: Radical Software, Dan Graham and the Legacy of Gregory Bateson’ in *Art Journal* (CCA, Fall 2008), pp.87-107.

[87] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing and Environmental Knowing*, (Cambridge MA: MIT, 2005), p.ix.

[88] Stewart Brand himself is of course also a complex and controversial figure here. The publisher of the *Whole Earth Catalogue*, Brand oscillates between left and right forms of libertarianism. In the catalogue, for example, he gives a Milton Freidman book a positive review, as an example of “radical thinking”!!

[89] I am indebted to Andrew Pickering for thinking about the complex tendencies within cybernetics in royal/nomadic terms.

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[90] For example, Ranulph Glanville has made this point on several occasions in lectures.

[91] Francisco J Varela, Evan Thompson, Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, MA: MIT Press, 1991), p.5.

[92] Hayles, *How we became Posthuman*, p.8.

[93] Hayles describes her project as a study of three interrelated tendencies in post war society: firstly, "how information lost its body"; secondly, "how the cyborg was invented as a technological artefact and cultural icon"; and thirdly, "how a historically specific construction called the human is giving way to the posthuman" Ibid., p.2.

[94] Peter Harries-Jones, *A Recursive Vision: Ecological Understanding and Gregory Bateson* (Toronto: University of Toronto Press, 1995), p.104-05.

[95] Ross Ashby, quoted by Ranolph Glanville, Lecture University of Greenwich 2009.

[96] Klaus Krippendorff, ' A Second-order Cybernetics of Otherness' in *Systems Research* Vol. 13 No. 3 (1996), pp. 311-328.

[97] Alan Watts, *Psychotherapy East and West* (New York: Vintage, 1961), p.88.

[98] Gordon Pask's conversation theory suggests that we learn through interaction with others and the environment, and that these interactions can all be conceived of as conversations. In conversation with others we live through language, and for Pask our consciousness is distributed socially. When interacting with environments, we talk for both sides if necessary, through something like empathy.

[99] Although Gregory Bateson is no straightforward Whiteheadian, there are clear parallels, and this is not surprising: the Whiteheads and Batesons would regularly meet socially. (In fact apparently it was Mrs Whitehead who set up Gregory's parents on a date, so there would literally be no GB without Whitehead!) Whilst GB clearly shares much with Whitehead's process-based relational and organismic cosmology in general, it is also accurate to say that his own intellectual milieu was dominated by a number of others who were also Whitehead influenced thinkers. Notably GB was personally close to biologist Conrad Waddington (a Marxian Whiteheadian) going right back to his student days at Cambridge (GB edited Waddington's important 'Organisers and Genes'). Kurt Lewin, who developed Whitehead's field theory in psychology, was also very influential for Bateson, as was the Whiteheadian Alfred Korzybski.

[100] In this thesis of evolution proceeding by leaps and jumps, and not simply the gradual mutation of the neo-Darwinists, the Batesons were very much against the orthodoxy of their times, but would be returned to by later research - of for example Stephen Jay Gould. Interestingly, Gould would need to use dialectics to describe this process.

[101] Bateson, *Steps to an Ecology of Mind*, p.379.

[102] Greg Lynn has developed this in some interesting ways in his paper on 'The Renewed Novelty of Symmetry', originally published in *Assemblage 26*, (Cambridge, MA: MIT, 1995) pp.11-23

[103] See Gregory Bateson, 'A Reconsideration of Bateson's Rule' in *Steps to an Ecology of Mind*, pp.270-83.

[104] For a theorisation of the way that they used photography and film in their anthropological research, see the chapter 'Notes on photography and captions' in Gregory Bateson and Margaret Mead, *Balinese Character A Photographic Analysis* (New York: New York Academy of Sciences, 1942), pp. 49-54. This book opens with the statement that "the form of presentation used in this monograph is an experimental innovation" (p. xi). The first forty pages are an anthropological text on Balinese culture, largely by Mead. The majority of the book consists of photographs by Bateson, organised according to various themes. Bateson notes that he took 25000 Leica stills, and 22,000 feet of 16mm film. There are 759 stills in the book, of which 8 were posed.

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[105] For example, writing in 1942 Margaret Mead noted that "those students who have devoted themselves to studying cultures as wholes, as systems of dynamic equilibrium, can make the following contributions ... by recognising the importance of including the social scientist within his experimental material." Margaret Mead, 'The Comparative Study of Culture, and the Purposive Cultivation of Democratic Values', in Conference on Science, Philosophy and Religion and Their Relation to the Democratic Way of Life, *Second Symposium* (New York: Harper and Brothers, 1942) pp.55-69

[106] It is in this respect interesting to consider Bateson's position in regard to the 'critical realist' reading of natural and social science proposed by Roy Bhaskar, and the dialectical naturalist reading of Marx proposed by John Bellamy Foster (as discussed all-too-briefly in previous chapters).

[107] In 1951 Bateson published (with Jurgen Ruesch) the influential *Communication: The Social Matrix of Psychiatry,* which was a cybernetic theory of psychology.

[108] The concept of "double-bind" describes a condition wherein an individual is placed in an insoluble dilemma, due to receiving contradictory signals. In the classic psychiatric treatment of the concept, the child receives contradictory signals from the parent - typically one verbally transmitted in words, and the other physically transmitted, through body language, tone of voice etc.

Through the concept of the double-bind, Bateson produces something which seems to me to be entirely analogous to Gödel's critical discovery of an irreducible self-reflexivity at the heart of Bertrand Russell and Alfred North Whitehead's *Principia Mathematica* (i.e. what Russell and Whitehead had specifically hoped to avoid!). Gödel's critique of *Principia Mathematica* has been foundational to Douglas Hofstadter's recursive 'strange loop' thesis of consciousness. See Douglas R. Hofstadter, *Goedel, Escher, Bach: an Eternal Golden Braid - Twenty Year Edition*, (London: Penguin, 1999)

[109] Specifically, Bateson experimented with LSD on himself with the remit of exploring "the orders of aesthetics". For a discussion see Gregory Bateson, *A Sacred Unity: Further Steps to an Ecology of Mind* (New York: Harper Collins, 1991) pp.

[110] John Lilly was a friend of Bateson, and an important figure in the sixties counter-culture movement, and a general researcher into all aspects of consciousness. He invented the sensory deprivation isolation tank, and researched its effects, and pioneered research into inter-species communication – specifically with dolphins. Douglas Adams' character Wonko the Sane, who Arthur Dent visits to find out what had happened to the dolphins, in the final "Hitchhiker's" book *So long, and thanks for all the fish,* was (a tribute to) John Lilly.

[111] Some of this is documented in Gregory Bateson, 'Social Planning and the Concept of Deutero-Learning' in Bateson, *Steps to an Ecology of Mind*, pp.127-37.

[112] Bateson has a particular definition of epistemology, which he has defined as "a branch of science combined with a branch of philosophy. As science, epistemology is the study of how particular organisms or aggregates of organisms 'know', 'think' and 'decide'. As philosophy, epistemology is the study of necessary limits and other characteristics of the processes of knowing, thinking and deciding." Gregory Bateson and Mary Catherine Bateson, *Angels Fear: Towards an Epistemology of the Sacred* (Cresskill, NJ: Hampton Press and Institute for Intercultural Studies, 2005), p.208. Elsewhere, Bateson stated that "my epistemology ... is a branch of natural history. It was McCulloch who, for me, pulled epistemology down out of the realms of abstract philosophy into the much more simple realm of natural history. This was dramatically done in the paper by McCulloch and his friends entitled 'What the frog's eye told the frog's brain.' In that paper he showed that the answer to the question 'how can a frog know anything?' would be delimited by the sensory machinery of the frog; and that the sensory machinery of the frog could, indeed, be be investigated by experimental and other means" Gregory Bateson, 'Afterword', in John Brockamn (ed.) *About Bateson* (London: Wildwood House, 1977), p.237.
Bateson's work in emphasising the informational character of living systems is today seen as an important anticipation of the field of biosemiotic research. See, for example, Jesper Hoffmeyer (ed.), *A Legacy for Living Systems: Gregory Bateson as a Precursor to Biosemiotics* (Copenhagen: Springer, 2008).

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[113] In a great example of the productive and 'natural' character of pathology, Bateson observes that "the older an automobile gets and the further it is from the engineer who designed it, the more *complex* it gets with multiple 'pathologies' and the more it takes on characteristics of a *living* thing - moods, caprice, etc. New cars are 'it' but an old car is 'she'." Gregory Bateson, letter to Philip Wylie, June 1967. Accessed online 1.8.08 at http://www.oikos.org/batesleten.htm

[114] See, for example, Kaizen, 'Steps to an Ecology of Communication: Radical Software, Dan Graham and the Legacy of Gregory Bateson', pp.87-107

[115] Bateson, 'The Cybernetics of Self: A Theory of Alcoholism', p.319.

[116] For an account of Gregory Bateson's death, see Mary Catherine Bateson, 'Six Days of Dying', in *CoEvolution Quarterly*, 1980, Winter, No. 28, pp.4–11. Also located at: http://www.oikos.org/batdeath.htm

[117] Gregory Bateson and Mary Catherine Bateson, *Angels Fear: Towards an Epistemology of the Sacred* (Cresskill, NJ: Hampton Press and Institute for Intercultural Studies, 2005), pp.51-52.

[118] Gregory Bateson, in speech at AUM conference held at Esalen in March 1973 organised by Alan Watts, G Spencer Brown and John Lilly, quoted in Brockamn (ed.), *About Bateson*, p.4.

[119] Sergio Manghi, 'Foreword', in Gregory Bateson, *Mind and Nature: A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002), p.x.

[120] Verena Andermatt Conley, *Ecopolitics: The Environment in Poststructuralist Thought* (London: Routledge, 1997), p.48.

[121] Gregory Bateson, 'Afterword', in Brockamn (ed.) *About Bateson*, p.247.

[122] Giles Deleuze and Felix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (London: Athlone, 1984), p.80.

[123] Ibid., pp. 21-22.

[124] Gregory Bateson, 'Theory vs Empiricism' in Milton M Berger (Ed), *Beyond the Double Bind: Communication and Family Systems, Theories and Techniques with Schizophrenics* (NY: Brunner/Mazel, 1978)

[125] Bateson's conception of mind evolved over the course of several decades, and was first presented as a 'total' theory when he selected a series of essays and published them as *Steps to an Ecology of Mind* in 1972. He then formalised this further in *Mind and Nature: A Necessary Unity* in 1979.

[126] Bateson states that "the difference between a set and a group being that the members of a group a generated one from another, whereas a set is a list. Group theory is a very elegant little subject. It has a math of meta-relations about permutation and combination. Most atomic physics and things like this depend upon it nowadays. The periodic table of elements is essentially group theoretical." As quoted in Stewart Brand, *II Cybernetic Frontiers* (New York: Random House, 1974), p.37.

[127] Bateson, *Mind and Nature*, p.188.

[128] Bateson and Vrela first met at when they were both teaching at the Naropa Institute. In his calculas, Varela suggests that Hegelian dialectics is based upon an 'A/not A' distinction – i.e. both sides are at the same logical level. Varela proposes a dialectics based upon 'whole/parts constituting whole': "take any situation (domain, process, entity, notion) which is holistic (total, closed, complete, full, stable, self contained). Put it on the left side of the /. Put on the right side of it the corresponding processes [parts] (constituents, generators, dynamics)." Varela 'Not one, Not two' in *Coevolution Quarterly* (Fall 1976), pp. 62-7. For Varela whole and parts are 'imbricated' (overlapping), and he notes that "a whole decomposes into parts which generate processes integrating the whole." He does not see this as a negation of Hegelian dialectics (Hegelian/non-Hegelian), but rather an enfolding of it.

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129 Bateson sets out his criteria of mental process, all of which he thought must be met for a system to be a mind. However, for Bateson his conception of mind "must stand or fall, not by the particular content of my list, but by the validity of the idea that some such structuring of epistemology, evolution and epigenesis is possible. I propose that the mind-body problem is soluble along lines similar to those outlined here … [:]
(1) *Mind is an aggregate of interacting parts or components*.
(2) *The interaction between parts of mind is triggered by difference,* and difference is a nonsubstantial phenomenon not located in space or time; difference is related to negentropy and entropy rather than energy.
(3) *Mental process requires collateral energy*.
(4) *Mental process requires circular (or more complex) chains of determination.*
(5) *In mental process the effects of difference are to be regarded as transforms (i.e., coded versions) of the difference which preceded them.* The rules of such transformations must be comparatively stable (i.e. more stable than the content) but are themselves subject to transformation.
(6) The description and classification of these processes of transformation discloses a hierarchy of logical types immanent in the phenomena."
Bateson, 'Criteria of Mental Process', pp.85-86.

130 Gregory Bateson, 'Criteria of Mental Process', p.85.

131 For a discussion of emergence in relation to Bateson's thought, see Thomas E Malloy, Carmen Bostic St Clair, and John Grinder 'Steps to an Ecology of Emergence' in Frederick Steier and Jane Jorgenson (eds), *Cybernetics and Human Knowing* - special issue entitled *Gregory Bateson: Essays for an Ecology of Ideas* (Vol. 12, 1 and 2, 2005), pp.102-19.

132 The importance of a conception of logical type in Bateson's thinking has been emphasised by Mary Catherine Bateson. See Mary Catherine Bateson, *With a Daughter's Eye: A Memoir of Margaret Mead and Gregory Bateson* (New York: Harper Perennial, 1994), pp.206-10.

133 Morphogenesis – the processes by which plants and animals develop and grow, and are *informed* – is fiendishly complex and difficult to fully explain. Sheldrake at least makes *visible* the problem by proposing the existence/emergence of real ontological fields of information. This seems unlikely in the manner he proposes, but is not any more clumsy than the hopes attached to the standard genetic account. Bateson's semiotic-cognitive relational method of reformulating the question of morphogenesis as a communicational system of differences, procedurally *relating* or *networking* an organism and its context, seems an altogether more sophisticated way of conceiving of the nature/culture of morphogenesis.

In general, it is interesting to note Bruni's assertion that "it should not come as a surprise today to realise how the general ideas that Bateson was postulating for the study of communication systems in biology fit so well with the astounding findings of current molecular biology, for example in the field of cellular signal transduction networks. Once again he would be illustrating the fruitfulness of abduction, being as he was concerned with advancing the search for fundamental principles in communication processes in living systems at different hierarchical levels." Luis Emilio Bruni, 'Gregory Bateson's Relevance to Current Molecular Biology' in Hoffmeyer (ed.), *A Legacy for Living Systems*, p.95.

134 It is important to note here that Bateson was critical of some Darwinian conceptions of evolution. In particular, Bateson would emphasise (following Whitehead) that the fundamental unit of survival was *not* the organism, but was rather the organism *plus* its environment, which together must be considered to *co-evolve*. He emphasised that when an organism drifts into a state that starts to destroy its environment (i.e. its extended self), then it never survives.

135 Bateson, 'Criteria of Mental Process', p.85.

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[136] And in fact, on the occasions Bateson does, he tends to be critical. For example, in *Mind and Nature*, he briefly discusses the Marxist account of history as primarily determined by class forces rather than individuals. For Bateson, this position in its most vulgar form (and we can imagine what this might have been like in discussions in the 1970s!) is an example of an error in logical type (in fact he uses this as an example of this kind of error). The “class” is of a *different organisational and logical type* to the “individual”. Bateson notes that it *does* matter in which way any ‘movement’ starts, as systems are sensitive to initial conditions. He goes on to suggest that whilst in a vulgar Marxist account it might just be said that a theory of evolution would be produced, Bateson notes that the insights of cybernetics might have developed much earlier had Wallace beaten Darwin to publication, as Wallace understood the importance of the self-regulating steam governor. See Bateson, ‘Criteria of Mental Process’, p.40.

[137] Jesper Hoffmeyer, ‘From Thing to Relation: On Bateson’s Bioanthropology’ in Hoffmeyer (ed.), *A Legacy for Living Systems*, p.42.

[138] It is interesting in this regard to recall that in Eyal Weizman’s brilliant analysis of the way in which Deleuzian spatial tactics were being deployed by the Israeli military (see Eyal Weizman ‘Walking through Walls’ accessed 30.8.10 from http://eipcp.net/transversal/0507/weizman/en). The first academic that the Israeli general Shimon Naveh (until 2006 co-director of the Operational Theory Research Institute) referred to in an interview with Weizman was “Gregory Bateson”. I would imagine that they might have been particularly interested in Bateson’s Palo Alto therapy work on individuals and social groups, which showed how disruptions, double binds, new feedback and other changes to *messages and communication flows*, could quickly lead to pathological breakdown in individuals and social groups – an analysis which might easily be turned to suit the needs of the war machine.

[139] Giles Deleuze and Felix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (London: Athlone Press, 1984), p.236.

[140] Harries-Jones, *A Recursive Vision*, pp.29-32.

[141] Niklas Luhmann, quoted as preface in Hans-Georg Moeller, *Luhmann Explained: from Souls to Systems* (Chicago and Las Salle: Open Court, 2006). In the same volume, Moeller states: “Marxist attentiveness to production and thus to economy overstates this social system in regard to its constituting power for all of society ... the differentiation of the economy as a self-constructing social system does not prevent other systems from unfolding their own autopoeitic operations ... at the same time, however, the primary focus on the economy also underestimates this system’s capacity to continuously change itself, and enter into extremely complex couplings with other social systems such as law, politics, and the mass media.” Ibid., p.179. Of course, as is made clear by the terms used in this quote – Luhmann was indebted more to Maturana and Varela than Bateson.

[142] This event was primarily organised by R.D. Laing and David Cooper. Bateson gave the paper on ‘Conscious Purpose vs Nature’ (which was later also published in *Steps to an Ecology of Mind.*) The proceedings were published as David Cooper (ed.), *The Dialectics of Liberation* (Harmondsworth and Baltimore: Penguin, 1968).

[143] Noel G. Charlton, *Understanding Gregory Bateson: Mind, Beauty, and the Sacred Earth* (New York: SUNY Press, 2008), p.26.

[144] Mary Catherine Bateson, *Our Own Metaphor: Effects of Conscious Purpose on Human Adaptation* (New York: Knopf, 1972), p.16.

[145] Gregory Bateson, Box 6 Manuscripts ‘Mind in Nature’, 17 November 1977 (unpublished), quoted in Peter Harries-Jones, “Gregory Bateson’s ‘Uncovery’ of Ecological Aesthetics” in Hoffmeyer (ed.), *A Legacy for Living Systems*, p.158. There is a published though slightly different version of this in Gregory Bateson, *Mind and Nature*, p.10.

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[146] I am broadly indebted to Peter Harries-Jones here, who has repeatedly emphasised that Bateson's "clear purpose" was in "establishing rapport between aesthetics and a reconstructed science" Peter Harries Jones, 'Understanding Ecological Aesthetics' in Steier and Jorgenson (eds), *CHK: Gregory Bateson: Essays for an Ecology of Ideas,* p.66.

The 'second vision' of Bateson's 'ecological aesthetics' of course refers to the William Blake letter to Thomas Butts, on 22 November 1802 (accessed online 23.2.11 at http://www.128path.org/pathtimes/article4.html):

"Now I a fourfold vision see,
And a fourfold vision is given to me;
'Tis fourfold in my supreme delight
And threefold in soft Beulah's night
And twofold Always. May God us keep
From Single Vision & Newton's sleep!"

[147] James Lovelock, *Gaia: A New Look at Life on Earth* (1979), p.10

[148] Gordon Pask, 'The Architectural Relevance of Cybernetics' in *Architectural Design* 1969, p.

[149] Ibid.

[150] Ibid.

[151] Alan Colquhoun, 'Plateau Beaubourg', in *Essays in Architectural Criticism: Modern Architecture and Historical Change* (Cambridge, MA: MIT, 1981), p.117.

[152] Jonathan Crary quoted in Felicity D. Scott, *Architecture or Techno-Utopia - Politics after Modernism* (Cambridge, MA: MIT, 2007) p.261.

[153] Sanford Kwinter, *Architecture of Time: Towards a Theory of the Event in Modernist Culture* (Cambridge, MA: MIT, 2002) p.8.

[154] Gregory Bateson, *Mind and Nature - A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002) p. 7.

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[1] William Blake, *The Marriage of Heaven and Hell* (New York, NY: Dover, 1994), p.4.

[2] Gregory Bateson, 'Neither Supernatural nor Mechanical' in Gregory Bateson and Mary Catherine Bateson, *Angels Fear: Towards an Epistemology of the Sacred* (Cresskill: Hampton Press, 2005), p.59.

[3] For Tafuri, it is the task of the architectural historian to (in the words of Andrew Leach) "clear the ground for architectural practice" (quote from research seminar at University of Westminster, May 2007 - hosted by author) through an ideological criticism of architecture. See Andrew Leach, *Choosing History* (Ghent: A&S Books, 2007). In Tafuri's own words, this work involves "the precise identification of those tasks which capitalist development has taken away from architecture. That is to say, what it has taken away in general from ideological prefiguration." Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* (Cambridge, MA: MIT Press 1992), p.ix.

[4] Terry Eagleton, Introduction in Terry Eagleton (ed.), *Ideology* (Harlow: Longman, 1994), p.1.

[5] Ibid.

[6] Ibid., p.6.

[7] Karl Marx and Frederick Engels, *The German Ideology*, in Robert C. Tucker (ed.), *The Marx-Engels Reader Second Edition* (New York and London: W. W. Norton and Co., 1978) p.158.

[8] Ibid., p.154.

[9] Ibid., p.154.

[10] Ibid., p.155.

[11] Bateson uses "Neither Supernatural nor Mechanical" as the title of a chapter in *Angels Fear: Towards an Epistemology of the Sacred*, pp.50-64.

[12] Bateson developed this important formulation in many papers, most notably in the paper on 'Form, Substance and Difference', which was given as the 19th Annual Korzybski Memorial Lecture in 1970. See Gregory Bateson, 'Form, Substance and Difference' in *Steps to an Ecology of Mind* (Chicago: University of Chicago Press, 2000), p.459

[13] Ibid., p.467.

[14] Karl Marx, *Economic and Philosophic Manuscripts of 1844,* in Tucker (ed.), *The Marx-Engels Reader*, p.75.

[15] Bateson, 'Form, Substance and Difference', p.465.

[16] Ibid., p.316.

[17] Gregory Bateson, *Mind and Nature: A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002), p. 89. The "criteria" that Bateson refers to are set out in the footnote above.

[18] Ibid., pp.86-87.

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[19] Even if an undifferentiated and autonomous object is conceivable, we could presumably never know such a thing, as it must surely be incapable of interacting with anything else? As touched upon in Chapter Two, quantum and relativity theories suggest that so-called fundamental particles can only be understood as networks, or patterns of differentiated relations and energetic events. Many of the more ecocentric and holistic interpretations of this science (including those from within theoretical physics, such as Capra and Bohm), do suggest that "process-pattern" based accounts of "matter" mean that, at some level, matter in its most fundamental forms does meet, in a most basic way, Bateson's criteria of mental process. Indeed, Bateson seemed to come close to accepting this point elsewhere. Certainly, the mathematics of group theory that Bateson would use in his later work to describe the kinds of recursive processes that he considered 'mental' is fundamentally the same as used to describe Geoffrey Chew's bootstrap hypothesis of quantum mechanics, or String theory or even more recent theoretical physics, such as the elegant Lie Group based hypothesis of relational patterns of sub-atomic particles of Garrett Lisi in his 'Exceptionally Simple Theory of Everything' – described by leading cosmologist Lee Smolin, as "one of the most compelling unification models I've seen in many, many years" (quoted in Zeeya Merali, 'Is mathematical pattern the theory of everything?' in *New Scientist*, 15 November 2007. Accessed 1.7.09 at http://www.newscientist.com/article/dn12891-is-mathematical-pattern-the-theory-of-everything.html?full=true). For a great animation showing the elementary particles as a 248-dimension pattern based upon the famous Lie E_8 geometry, see the very short *New Scientist* documentary at: http://www.youtube.com/watch?gl=GB&hl=en-GB&v=-xHw9zcCvRQ and a longer presentation by Garrett Lisi at TED: http://www.youtube.com/watch?v=y-Gk_Ddhr0M

[20] Gregory Bateson in a letter to Philip Wylie, June 1967. Accessed 1.7.09 at http://www.oikos.org/batesleten.htm

[21] Gregory Bateson, 'Effects of Conscious Purpose on Human Adaptation', in *Steps to an Ecology of Mind*, p.450. This is the invitation text and position paper for his 1968 conference of the same title.

[22] In Buddhist-inspired thinking, something very similar to what Bateson refers to as "consciousness" is referred to as "Mind". In these traditions, "Mind" is often used to describe that aspect of conscious ego awareness that needs to be recognised and relinquished, in order to allow a direct awareness of just "being present". The awareness and experience of just being present, is, Bateson, Varela and Thompson have all contended, close to a direct experience of what Bateson meand by "mind". So, Bateson's "consciousness" is Buddhist "mind", and Bateson's "mind" is Buddhist "awareness", roughly!

[23] Aphorism widely accredited J.J. Gibson, for example the wikipedia entry on Ecological Psychology, accessed 1.7.08 at http://en.wikipedia.org/wiki/Ecological_psychology

[24] Andy Clark, *Mindware: an Introduction to the Philosophy of Cognitive Science* (Oxford: Oxford University Press, 2001), p.ix.

[25] Although there is perhaps a revision of the more caricatured descriptions of Rene Descartes emerging in recent work. The artist and extended mind theorist Robert Pepperell often notes that the dualism frequently ascribed to Descartes is inaccurately portrayed. Similarly, Paavo Pylkkänen reminds us that David Bohm thought that it was possible to find in a certain reading of Descartes an anticipation of his conception of implicate order. See, for example Paavo Pylkkänen, *Mind, Matter and the Implicate Order* (Berlin, Heidelberg, New York: Springer, 2007) pp.101-05.

[26] This position can also be referred to as 'emergent materialism'. There are several forms of this: John Searle, for example, holds to a version of this called "biological naturalism".

[27] See Galen Strawson, 'Realistic Monism: Why Physicalism entails Panpsychism' in Galen Strawson et al., *Consciousness and its Place in Nature: Does Physicalism entail Panpyschism?* (Exeter: Imprint Academic, 2006), pp. 3-31.

[28] Paraphrased rom Antonio Damasio, *Descartes' Error: Emotion, Reason, and the Human Brain* (New York, NY: 1994), p.118.

[29] Karl Marx, 'Economic and Philosophic Manuscripts of 1844' in Tucker (ed.), *The Marx-Engels Reader*, p.88.

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[30] Evan Thompson, 'Empathy and Consciousness', *Journal of Consciousness Studies* 8 (2001), pp. 1-32.

[31] Importantly, they engaged with Buddhist knowledge in an open manner, noting that "the designation and delineation of 'religion' in the west is itself a cultural artefact that may, if taken literally, seriously hamper our understanding of other traditions." Fransisco J Varela, Evan Thompson and Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, MA: MIT Press, 1991), p.22.

[32] Ibid.

[33] Ibid., p.xvi.

[34] Ibid., p.38.

[35] Ibid., p.40.

[36] This is classically described in its pure form in the model of a Universal Turing Machine. This mode of thinking in cognitivism is well captured by the faux-slogan of cognitive science students: "no computation without representation!"

[37] Varela, Thompson and Rosch, *The Embodied Mind*, p.xx.

[38] An enormously reductive form of positivism, which basically treated the entire organism as a simplistic black box, which could then receive inputs.

[39] Varela, Thompson and Rosch, *The Embodied Mind*, pp.48-9.

[40] Ibid., p.50.

[41] See Ray Jacknedoff, *Consciousness and the Computational Mind* (Cambridge, MA: MIT Press/ Bradford, 1987).

[42] Varela, Thompson and Rosch, *The Embodied Mind,* p.85.

[43] The principles of the connectionist neural net approach were set out in the seminal 1943 paper by Warren McCullough and Walter Pits, 'A Logical Calculus of Ideas Immanent in Nervous Activity', first published in *Bulletin of Mathematical Biophysics* 5 (1943), and reprinted in Warren McCullough, *Embodiments of Mind* (Cambridge, MA: MIT, 1965).

[44] Stephen Wolfram would go on to publish his research in the magisterial *A New Kind of Science* (Wolfram Media, 2002), in which he argues nothing less than that cellular automata are the basic pattern generating algorithms behind literally all of life, the universe and everything (the structure of space and time included). In producing his research, Wolfram wrote what has become one of the most important mathematical software applications ever (both accessible and research-based): *Mathematica*. See http://www.stephenwolfram.com/ (which also has accessible online the full text to *A New Kind of Science,* plus many *Mathematica* based animations, scripts etc.).

[45] Varela, Thompson and Rosch, *The Embodied Mind,* p.100.

[46] Furthermore, they note, drawing in particular no doubt upon Varela's earlier work with Maturana, there are important domains of cognition defined by non-neural networks, such as immune systems.

[47] Varela, Thompson and Rosch, *The Embodied Mind,* p.101.

[48] Ibid., p.xx.

[49] In a sense, we might say that the kind of confused discussion that encircles David Chalmer's "hard problem of consciousness" regarding qualia is exactly what happens when the observations of Varela, Thompson and Rosch are not heeded!

[50] Varela, Thompson and Rosch, *The Embodied Mind,* p.3.

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[51] Ibid., p.21.

[52] Ibid., p.27.

[53] Ibid., p.28.

[54] Thompson has recently stated that: "If I may be bold, I think that although the ideas about embodied cognition in this book have been widely acknowledged and assimilated by the field, the book's central theme has yet to be fully absorbed. The theme is the need for back-and-forth circulation between scientific research on the mind and disciplined phenomenologies of lived experience. Without such circulation, the danger for the scientist and philosopher is nihilism, by which I mean the inability to stop experiencing things and believing in them in a way one's theory says is an illusion." Evan Thompson, 'Life and Mind' in Bruce Clark and Mark B.N. Hansen (eds), *Emergence and Embodiment: New Essays on Second-Order Systems Theory* (Durham, NC: Duke University Press, 2009), p.78. Thompson goes on to give as examples Thomas Metzinger's account of "being no-one" and Daniel Dennett's account of consciousness as the brain's "user illusion" as the kinds of nihilism (or we might say first-order error) that must follow a failure to experience the theory of experience.

[55] Varela, Thompson and Rosch, *The Embodied Mind,* p.103.

[56] First published as Andy Clark and David J. Chalmers, 'The Extended Mind', in *Analysis* 58 (1998), pp.10-23. It has since then been republished on several occasions, including most recently as an appendix in Andy Clark, *Supersizing the Mind: Embodiment, Action and Cognitive Extension* (Oxford: Oxford University Press, 2008), pp.220-32. All following references to the essay will be to this publication, as it is the most readily accessible.

The paper was famously accredited in the order Andy Clark and David Chalmers (i.e. not alphabetically), with the addendum that "authors are listed in order of degree of belief in the central thesis"; and certainly since then, the concept has been primarily developed by Clark. Although David Chalmers has recently written the introduction to Clark's latest book *Supersizing the Mind* and certainly does not disown the idea, the question of extended mind is not really central to his main concerns around the philosophy of consciousness. Chalmers was a student of Douglas Hofstadter (see Chapter Four, Figs.4.48-4.58 on *Design Research: Video Feedback as Rhythmanalysis*, for a discussion of Hofstadter's ideas on "Strange Loops"), although his work has not developed in the same direction. Chalmers has been primarily concerned with questions around the experience of qualia, and what he calls "the hard problem of consciousness" (often simply referred to today as "the hard problem"). For Chalmers, the "easy problem" is roughly what Bateson would call "mind" – that is, explaining complex behaviour on the basis of ideas around computation, emergence, feedback and so on. Whilst of course Chalmers is not really dismissing this as simple, he does assert that even a fully worked out account of mind and mental process in this sense, does not explain conscious experience: why it is *like something*. This has been controversial to say the least, and has provoked an enormous response. Today, almost every publication in the cognitive sciences makes some kind of statement with regard to their position regarding the hard problem.

Clark in particular has continued to develop his understanding of the concept, publishing a series of books on the subject, including most notably *Being There: Putting Brain, Body and World Together Again* (Cambridge, MA and London: MIT,1998), *Natural Born Cyborgs - Minds, Technologies and the Future of Human Intelligence* (Oxford: Oxford University Press, 2003), and as noted, most recently *Supersizing the Mind: Embodiment, Action and Cognitive Extension* (2008), which is the most extensive exploration of this version of the concept.

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[57] Robert K. Logan, although not central to my work here, has had an interesting career. Now an emeritus professor at the University of Toronto, he might be described as second-generation member of what has become known as the Toronto School of Communications, built around the work of Marshall McLuhan and Harold Innis, who were both based there. Logan collaborated with McLuhan, with whom he wrote a (soon to be finally published) book, and interestingly is currently collaborating with Stuart Hoffmann (of the seminal Santa Fe Institute). His work has focused on language and media ecology, and might broadly be described as a dynamic systems approach to understanding language evolution and its effects upon human culture and society. Following his first use of ‘extended mind’ (in the paper Robert K. Logan, ‘The extended mind: understanding language and thought in terms of complexity and chaos theory’, in Lance Strate (ed.), *Communication and Speech Annual Vol. 14.* (New York: The New York State Communication Association, 2000)), he has also recently published a book developing the ideas further: Robert K. Logan, *The Extended Mind: The Emergence of Language, the Human Mind and Culture* (Toronto: University of Toronto Press, 2007).

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[58] For Rupert Sheldrake, the concept of extended mind describes some aspects of what he calls 'morphic fields'. These fields are for Sheldrake real entities. He states for example: "our minds are centred in our bodies, and in our brains in particular. I suggest however, that they are not confined to our brains, but extend beyond them. This extension occurs through the fields of the mind, or mental fields, which exist both within and beyond our brains." Rupert Sheldrake, *The Sense of Being Stared At, and other aspects of the Extended Mind* (London: Arrow, 2003), p.10. Elsewhere he writes: "mental fields are kinds of morphic fields. These are a new kind of field, in addition to the gravitational, electrical, magnetic and quantum matter fields already recognised by physics ... other kinds of morphic fields include morphogenetic fields involved in the development of animals and plants, shaping the forms into which they grow. Behavioural fields organise the behaviour of animals by patterning the activities of the nerve cells in their brains. Social fields link together the members of social groups and help to coordinate their activities in such a way that societies act like a single organism, as in ant colonies, flocks of birds, schools of fish or packs of wolves. Morphogenetic fields, behavioural fields, social fields and mental fields are all different kinds of morphic fields. All morphic fields shares common properties, and all contain an inherent memory given by a process called morphic resonance." (op. cit., p.16).

Whilst his early work, such as the book *A New Science of Life*, was initially acknowledged by many peers as an insightful charting of the aporias of orthodox modern biology, he was soon subject to little more than a character assassination by John Maddox, the chief editor of the journal *Nature*. In an editorial entitled 'A book for burning', Maddox stated that "Sheldrake's argument is an exercise in pseudo-science. Many readers will be left with the impression that Sheldrake has succeeded in finding a place for magic within scientific discussion – and this, indeed, may have been a part of the objective of writing such a book". He went on to add: "Sheldrake's is not a scientific theory. Sheldrake is putting forward magic instead of science, and that can be condemned, in exactly the language that the Pope used to condemn Galileo, and for the same reasons: it is heresy." Despite this inquisition, Sheldrake did receive some support – *New Scientist*, for example, described the book as "an important scientific inquiry into the nature of biological and physical reality," and accused *Nature* of "trial by editorial", whilst the aforementioned physicist David Bohm suggested that his thesis on implicate order might support Sheldrake's conception of morphogenetic fields.

Sheldrake argues that the very idea of there being fixed laws of science, which somehow exist outside of matter, is a return to Platonic form. The attack on Sheldrake was in no doubt in part inspired by his criticism of some of the basic assumptions about experimental science, such as the way that laboratory conditions by definition try to isolate themselves from broader environments, even though these broader contexts might be surprisingly critical to understanding what is happening in a given situation.

In any case, Sheldrake effectively gave up on establishing a career within orthodox science, increased the scope of his speculations, and now occupies a somewhat celebrity role within the often murky fields of Gaian and Consciousness Studies. Nonetheless, it can be difficult to see exactly what it is that differentiates in kind the work that Sheldrake produces, compared with for example the equally speculative (and arguably less experiment-based) concepts put forward by the self proclaimed defender of rationality, Richard Dawkins – whose ever stimulating meta-narrative fabrications I also refer to in this study.

The way that the phenomenon of (strong) emergence works requires a dialectical model based upon a philosophy of internal relations. If you don't have a relational and dialectical systems model of "reality", then actually emergence, and a whole bunch of related phenomenon, can only be explained and described through the imagining of something like morphic fields. Sheldrake is just giving substance to what in every case are the idealist mystifications of non-dialectical emergence theory (i.e. the normal kind). If you don't ascribe some kind of ontological reality to relational spacetime, then you must resort to some kind of mystification. Sheldrake's fields are just a clearer expression of this "mystification" than the dominant theories of emergence, which generally have no robust theoretical conception of "downward causation", "autopoiesis" etc.

[59] Clark, *Supersizing the Mind*, p.xxviii.

[60] For example, at the more speculative end of the field, many of the "quantum-mind" approaches (which might include the thinking of David Bohm, David Peat, Stuart Hameroff and Roger Penrose) might also be described as *strong* extended mind theories, in so far as they suggest direct non-local connections (implications) between percepts and objects.

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[61] See, for example, Roy Ascott (ed), *Engineered Nature: Art and consciousness in the post-biological era*
(Bristol: Intellect Books, 2006).

[62] See Nicolas Bourriaud, *Relational Aesthetics* (Dijon: Les Presses du Réel, 2002)

[63] Robert Pepperell, ‘Art and Extensionism’ in Riccardo Manzotti (ed.), *Situated Aesthetics. Art Beyond the Skin*, (Thorverton: Imprint Academic, forthcoming 2011)

[64] Neuroaesthetics is the name that has been given by Semir Zeki (a neurologist based at Wellcome Trust/UCL) to a field of research that has emerged over the last decade, in particular around figures such as Zeki himself, and V.S. Ramachandran, who – in addition to the seminal and creative work in neurology and cognition (around conditions such as synaesthesia, and phantom limb syndrome which I refer to extensively below) – has written a series of articles proposing “eight laws of artistic experience” as the neurological foundations of aesthetics.

The key journals of neuroaesthetics would include Semir Zeki’s site http://neuroesthetics.org/, and soon to start *Journal of Neuroaesthetics*. In addition, Warren Neidich edits the online Journal of Neuro-Aesthetic Theory, available at www.artbrain.org. The *Journal of Consciousness Studies* has published several articles by Zeki and Ramachandran on the subject. A useful challenge to some of the assumptions of neuroaesthetics can by found in the paper John Hyman, ‘Art and Neuroscience’, on the Art and Cognition Workshops website (organised by the Department of Cognitive Studies at the Ecole Normale Supérieure) which can be found at http://www.interdisciplines.org/artcognition

For Ramachandran’s neuroaesthetic speculations, see V.S. Ramachandran and William Hirstein, ‘The Science of Art - A Neurological Theory of Aesthetic Experience’ in *Journal of Consciousness Studies*, Vol. 6, No. 6-7, 1999, pp.15–51.

[65] Clark and Chalmers, ‘The Extended Mind’, p.220.

[66] Ibid.

[67] In addition to Gregory Bateson, the other “large subterranean influences” listed were M. Merleau Ponty, M. Heidegger, L. Vygotsky, J.J. Gibson and B. Latour, in Clark, *Natural Born Cyborgs*. p.iv.

[68] Clark and Chalmers, ‘The Extended Mind’, p.222.

[69] Ibid., pp.224-5.

[70] Ibid., p.225.

[71] David Kirsch ‘The Intelligent use of Space’, *Artificial Intelligence,* 73 (1995), p.31.

[72] Ibid., p.34.

[73] Clark notes that “no right-minded cognitive scientist, to be sure, ever claimed that body and world were completely irrelevant to the understanding of mind. But there was, nonetheless, an unmistakable tendency to marginalize such factors: to dwell on inner complexity whilst simplifying or ignoring the complex inner-outer interplays that characterize the bulk of basic biological problem-solving.” Andy Clark, ‘Embodiment and the Philosophy of Mind’ in A. O'Hear (Ed.) *Current Issues in Philosophy of Mind: Royal Institute of Philosophy Supplement 43* (Cambridge: Cambridge University Press,1998), p.35.

[74] Ibid., p.35.

[75] Ibid., p.36.

[76] Ibid., p.40.

[77] Ibid., p.41.

[78] Scott Kelso’s work has been exceptionally well received as a contemporary distillation of self-organisation theory. See, for example, J.A. Scott Kelso, *Dynamic Patterns - The Self-Organisation of Brain and Behaviour* (Cambridge, MA:MIT, 1995)

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[79] Clark, ‘Embodiment and the Philosophy of Mind’, p.41.

[80] Notably Maurice Merleau-Ponty, but also Martin Heidegger too is having a no doubt unanticipated afterlife providing concepts such as ‘transparent technology’ to a new generation of cognitive scientists. See Varela, Thompson, and Rosch, *The Embodied Mind*.

[81] Clark and Chalmers, ‘The Extended Mind’, p.225.

[82] They refer to S. Ullman and W. Richards, *Image Understanding* (Norwood, NJ: Ablex, 1984), and A. Blake and A. Yuille (eds.), *Active Vision* (Cambridge, MA: MIT, 1992).

[83] Saccades are the way that the eye makes rapid momentary adjustments outside of conscious awareness, focusing on different areas in a scene, repeatedly moving back and forth.

[84] They anticipate that here the work of Logan (see footnote 57), independently it seems, developed an extended mind account of language. They also do not refer to the work of second-order cyberneticians – in particular Gordon Pask, and his Conversation Theory, which deals with the question of language and extended mind.

[85] One of the most persuasive examples of a close coupling between organism and its environment is based upon research by M. Triantafyllou and G. Triantafyllou (see M. Triantafyllou and G. Triantafyllou, ‘An Efficient Swimming Machine’ in *Scientific American* (vol. 272, no. 3), pp.64-70) which has shown that the “extraordinary efficiency” of fish in water is due to what Clark and Chalmers describe as “an evolved capacity to couple its swimming behaviours to the pools of external kinetic energy found as swirls, eddies and vortices in its watery environment ... building these externally occurring processes into the very heart of its locomotion routines. The fish and surrounding vortices together constitute a unified and remarkably efficient swimming machine.” Clark and Chalmers, ‘The Extended Mind’, p.225-26.

[86] “Cognitive linguistics is characterised by adherence to three central positions. First, it denies that there is an autonomous linguistic faculty in the mind; second, it understands grammar in terms of conceptualisation; and third, it claims that knowledge of language arises out of language use.” William Croft and D. Alan Cruse, *Cognitive Linguistics* (Cambridge: Cambridge University Press, 2004), p.1.

[87] George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought* (New York: Basic Books, 1999), p.266.

[88] Ibid., p.17.

[89] Ibid., p.20.

[90] Ibid.

[91] For their discussion of this see Lakoff and Johnson, *Philosophy in the Flesh,* pp. 75-77. It should be noted that the term ‘generation’ does not imply a strict temporal distinction, but is conceived in much the same way as the cybernetic orders - which they do not refer to.

[92] Ibid., p.76.

[93] Ibid., p.77.

[94] Ibid.

[95] Lakoff and Johnson’s argument that our ability to conceive ideas is limited by a language that is rooted in bodily experience, is in fact closely related to arguments made by Neils Bohr in his Copenhagen Interpretation of quantum mechanics in relation to the limitations of language-based concepts in describing quantum reality, and also to David Bohm’s extension/criticism of Bohr’s position – both of which I have referred to briefly in Chapter Two.

[96] See Lakoff and Johnson, *Philosophy in the Flesh*, p.561.

[97] Ibid., p.562.

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[98] Ibid., p.266.

[99] Ibid., p.566.

[100] Andy Clark and David J. Chalmers, ‘The Extended Mind’, pp.10-23.

[101] Aristotle, *Metaphysics*, Book 8 Pt 6, accessed 1.9.10 at http://classics.mit.edu/Aristotle/metaphysics.8.viii.html

[102] Hugo Letiche states that “Bergson's name for emergence is élan vital.” Hugo Letiche, ‘Phenomenal complexity theory as informed by Bergson’, *Journal of Organizational Change Management*, Vol 13 No 6, (2000), pp.545–557.

[103] In some useful additional online resources (see http://mitpress.mit.edu/emergence/) associated with their book - Mark A. Bedau and Paul Humphreys (eds), *Emergence: Contemporary Readings in Philosophy and Science* (Cambridge, MA: MIT Press, 2008) - Bedau and Humphrey’s provide as classic texts of emergence: John Stuart Mill, ‘Of the Composition of Causes’ (1843), C Lloyd Morgan, *Emergent Evolution* (1921-22), C. D. Broad, *Mind and its Place in Nature* (1925), and Stephen Pepper, *Emergence* (1926).

[104] Mark A. Bedau, ‘Weak Emergence’ in James Tomberlin (ed.), *Philosophical Perspectives: Mind, Causation and World, vol. 11* (Oxford: Blackwell, 1997), p.379.

[105] Ibid., p.376.

[106] David Braddon-Mitchell, ‘Against Ontologically Emergent Consciousness’ in Brian P. McLaughlin and Jonathan Cohen (eds),*Contemporary Debates in Philosophy of Mind* (Oxford: Blackwell, 2007), p.288.

[107] David Chalmers, ‘Strong and Weak Emergence’ in P. Clayton and P. Davies, (eds), *The Re-emergence of Emergence* (Oxford: Oxford University Press, 2006). p.246.

[108] Evan Thompson notes in this regard: “... science has barely begun to chart this vast sea of nonlinearity and stochasticness. Within this context, ‘deterministic’ seems best understood as describing certain nonlinear analysis techniques (those in which there are no noise terms), not as an ontological characteristic of nature (in a classical observer-transcendent sense).” Evan Thompson, *Mind in Life: Biology, Phenomenology and the Sciences of Mind* (Cambridge MA: Belknap Press of Harvard University Press, 2007), pp.430-31.

[109] Ibid., p.431.

[110] This possibility is particularly interesting given how Marx/Engels Dialectics of Nature research might be complemented today through second-order systems theory.

[111] Lucien Sève, ‘Dialectics of Emergence’ in Bertell Ollman and Tony Smith (eds), *Dialectics for the New Century* (New York: Pallgrave Macmillan, 2008), p.88.

[112] Ibid., pp.93-4.

[113] Thompson, *Mind in Life*, pp.440-1.

[114] See for example Mark H. Bickhard, ‘Emergence: Process Organization, not Particle Configuration’ in *Cybernetics and Human Knowing* Vol 15, No 3-4 (2009), pp. 57-63: and Richard J. Campbell and Mark H. Bickhard, ‘Physicalism, Emergence and Downward Causation’ (2001) available online at www.lehigh.edu/~mhb0/physicalemergence.pdf.

[115] See Mark Wigley, *The Architecture of Deconstruction: Derrida’s Haunt* (Cambridge, MA: MIT, 1995).

[116] Rupert Sheldrake, *The Sense of Being Stared At, and other aspects of the Extended Mind* (London: Arrow, 2003), p.10-11.

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[117] S.Collins, M. Wisse and A.Ruina, ‘A Three-dimensional Passive-dynamic Walking Robot with Two Legs and Knees’ in *International Journal of Robotics Research* (Vol 20, No. 7 July 2001) pp. 607-615

[118] See E. Thelen and L. Smith, *A Dynamic Systems Approach to the Development of Cognition and Action* (Cambridge, MA: MIT, 1994)

[119] Victoria Watson, ‘On Drawing Forth, Designs and Ideas’ in Jane Rendell, Jonathan Hill, Murray Fraser, and Mark Dorrian (Eds.), Critical Architecture (London: Routledge, 2007) p. 237

[120] ibid. pp.238-39.

[121] See for example ‘On the Romanticism of Immersive Technological Environments’ in Medium Architecture, (Weimar: Bauhaus University Weimar Press, 2003) and ‘Brand New Tafuri’, in Journal of Architecture (London: Routledge, Summer 2001)

[122] See, for example, Ed Robbins, *Why Architects Draw* (Cambridge, MA: MIT, 1994), and Jon Goodbun and Karin Jaschke ‘Means of (Re-) Production’, in Paul Davies and Torsten Schmiedeknecht, *The Architect’s Guide to Fame* (London: Architectural Press, 2005)

[123] Robin Evans, *The Projective Cast - Architecture and its Three Geometries* (Cambridge, MA: MIT, 1995) p.

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[1] Max Horkheimer, *Critical Theory* (New York: Herder and Herder, 1972) p.200.

[2] Alva Noë in interview with Ginger Campbell, June 5, 2009, Transcript of *Brain Science Podcast No. 58*, accessed on 1.7.09 at www.brainsciencepodcast.com

[3] In fact, this is not only in relation to architectural thinking. The various strands of body/space research have not been brought together in one place as neurological and psychological research (as far as I am aware).

[4] See footnote 64 in Chapter Five for a brief discussion of the emerging discourse of neuroaesthetics.

[5] With the exception of sponges. However, sponges are better understood as a community of single cell organisms, that have a collective emergent behaviour.

[6] See Carl Sagan, *The Dragons of Eden - Speculations on the Evolution of Human Intelligence* (NY: Ballantine Books, 1977), pp.62-63.

[7] And in particular the so called limbic system is not really seen as a single coherent system any longer.

[8] There has in the past been a lot of debate about whether to approach the brain and the mind through a modular understanding or an holistic approach. To some extent these reflect different disciplinary interests. AI researchers have tended to focus on certain kinds of functional modularity – for example. V.S. Ramachandran has argued that both approaches seem to be correct, for different sub-brain regions, or different processes; he suggests that the oldest parts of the brain, in evolutionary terms, are largely modular, whereas the newest parts of the brain, and in particular the frontal cortex, which is where most of the most distinctively human activity takes place, is largely massively cross-wired and a plastic whole.

[9] V.S. Ramachandran and Sandra Blakeslee, *Phantoms in the Brain - Human Nature and the Architecture of the Mind* (London: Harper Perennial, 2005) p.177.

[10] J.A. Armour and R. McCraty have been, in very different ways, amongst those who have led research into neurocardiology, and their findings can be read as a provocative addition to embodied and extended mind (in McCaty's case) thinking.

[11] Researchers suggest that there are neural connections from the heart to the brain running through the medulla into the amygdala, and into the spinal column through the vagus nerve.

[12] Again, it is important to note that neural-net-type processes (i.e. a particular kind of relational organisation), are not only found constructed through actual neurons in the body. Other related forms of *computation* occur through all kinds of other chemical systems within the body, and between the body and its environment.

[13] See, for example, J.A. Armour, *Neurocardiology: Anatomical and Functional Principles* (New York, NY, Oxford University Press, 1994), and J.A. Armour and Jeffrey L. Ardell (eds.), Neurocardiology (New York, NY, Oxford University Press, 1994)

[14] See McCraty R, Bradley RT, Tomasino D, 'The Resonant Heart' in *Shift: At the Frontiers of Consciousness* No. 5 (2004) pp.15-19.

[15] For a (very "new age") discussion of the cognitive role of the heart in relationship to external living environments, see Stephen Harold Buhner, *The Secret Teachings of Plants -The Intelligence of the Heart in the Direct Perception of Nature* (Rochester, Vermont: Bear and Co., 2004).

[16] There appears to be remarkably little experimental research being done in this area, and it is difficult to tell whether this is because it is such a potentially career limiting area for scientists to be associated with, or because there is just nothing there to research.

[17] Ramachandran and Blakeslee, Phantoms in the Brain, p.34.

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[18] Gregory Bateson, *Mind and Nature - A Necessary Unity* (New York: Bantam Books,1980), p.118.

[19] The point is that if extant, whilst these 'new' senses might be considered to be in some way operating at a lower and more direct level, they are nonetheless ultimately just more mediated senses that need to be treated according to the general discussion of empathy, mental representation and cognitive mapping that follows. They amplify and intensify perhaps the extent of the mind's environmental extension and ecological immersion, but no more than that.

[20] See E.C. Tolman, 'Cognitive Maps in Rats and Men', in *Psychological Review,* 55 (1948), pp. 189-208.

[21] See for example, Robert M. Kitchin, 'Cognitive Maps: What are they and why study them?', *Journal of Environmental Psychology,* 14 (1994), pp.1-19.

[22] See for example Kevin Lynch, *The Image of the City* (Cambridge, MA, 1960).

[23] See Wilder Penfield and Theodore Rasmussen , *The Cerebral Cortex of Man* (New York: Macmillan, 1950)

[24] See Catherine Brahic 'Birds can 'see' the Earth's magnetic field' in New Scientist 30 April 2008, accessed 1.7.09 from http://www.newscientist.com/article/dn13811-birds-can-see-the-earths-magnetic-field.html

[25] The somatic senses are the oldest evolutionary senses, and include touch, temperature, nocioception (pain), proprioception (the location and movement of body parts,) and balance.

[26] Ramachandran and Blakeslee, *Phantoms in the Brain,* p.33.

[27] See Sandra Blakeslee in conversation with Ginger Campbell in Brain Science Podcast no. 23 (accessed on 1.5.09 at http://docartemis.com/brainsciencepodcast/previous-episodes/transcripts/, and Sandra Blakeslee and Matthew Blakeslee, *The Body Has a Mind of Its Own* (NY: Random, 2007), p.11.

[28] Regarding the use of the body and emotions in cognition, see Antonio Damasio, *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* (New York: Harcourt, 1999).

[29] Ramachandran and Blakeslee, *Phantoms in the Brain,* p.77.

[30] Sandra Blakeslee and Matthew Blakeslee, *The Body Has a Mind of Its Own* (NY: Random, 2007), p.37.

[31] This experiment is widely reported, but most famously perhaps in Richard L Gregory, *Eye and Brain - The Psychology of Seeing* (London: World University Library, 1966)

[32] The extraordinary extent to which our vision is haptic and multisensory is, in my view. brought out by recent experiments with blind individuals where video cameras have been linked up to sensory patches on their arms. Initially these experiments did not work at all. However, apparently in frustration, one of the test subjects picked up the camera (it had been static on a tripod), and practically as soon as he did so, as soon as he could correlate body movement with the signals that he was feeling on his arm, his visual cortex was able to start to make sense of the information, and start to 'construct an image'. After a while it has been possible for individuals to engage in complex and fast feedback activities, such as catching a ball thrown to them, just on the basis on 'images' formed on the basis of video to skin. Using similar methods, the US Navy SEALs are working with deep underwater cameras feed onto touch pads connected to the divers tongues, for conditions where it is too dark to see. In general it seems to me that this discussion reveals the problem of accusing contemporary culture of being too visual – it could not be visual without other senses. To see something as too visual in some way is to misunderstand how the senses are working. For a further discussion of seeing with the hand, see Giacomo Rizzolatti and Corrado Sinigaglia, *Mirrors in the Brain: How our minds share actions and emotions* (Oxford: OUP, 2006), p. 50.

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[33] It is I think extremely instructive to reflect upon the accuracy of the insights of the empathy theorists with regard to anticipations of recent neurological research. Consider for example now the following passage from August Schmarsow: “Psychologically, the intuited form of three-dimensional space arises through the experiences of our sense of sight, whether or not assisted by other physiological factors. All our visual perceptions and ideas are arranged, and ordered, and unfold in accordance with this intuited form ... The intuited form of space, which surrounds us wherever we may be and which we then always erect around ourselves and consider more necessary than the form of our own body, consists of the residues of sensory experience to which the muscular sensations of our body, the sensitivity of our skin, and the structure of our body all contribute. As soon as we have learned to experience ourselves and ourselves alone as the centre of this space, whose co-ordinates intersect in us, we have found the precious kernel, the initial capital investment so to speak, on which architectural creation is based.” (August Schmarsow, ‘The Essence of Architectural Creation’, in Harry Mallgrave and Eleftherios Ikonomou (eds.), *Empathy, Form, Space: Problems in German Aesthetics 1873-1893* (Santa Monica, CA: Getty Centre, 1994) p.286.) This statement is interesting because it is typical of the “accuracy” that can be found in many artistic and introspective first person accounts of first person processes, and indeed, as Varela, Thompson and Rosch noted (see previous chapter), in other traditions based upon rigorous first person interio-reflection. This is in fact a reason for some optimism concerning the possibility of new forms of what neurophenomenologists such as Francisco Varela, Shaun Gallagher and Evan Thompson have described as “first person science”.

[34] Rizzolatti and Sinigaglia, *Mirrors in the Brain*, p.xi.

[35] V.S. Ramachandran and Sandra Blakeslee, *Phantoms in the Brain - Human Nature and the Architecture of the Mind* (London: Harper Perennial, 2005) p.70.

[36] See Marvin Minski, *The Society of Mind* (New York, 1988). Jerry Fodor, has in ‘The Modularity of Mind’, argued for a modular conception of the brain, that, whilst problematic for reasons discussed above more broadly, does have something useful to say regarding the conception of the mind as an assemblage, network or society of sub-brains. He has elsewhere stated: “if, in short, there is a community of computers living in my head, there had also better be somebody who is in charge; and, by God, it had better be me.” Jerry Fodor, *In Critical Condition* (Cambridge: MIT, 1998) p.207.

[37] Sandra Blakeslee and Matthew Blakeslee, *The Body Has a Mind of Its Own* (NY: Random, 2007), p.109.

[38] Ibid., p.41.

[39] Ibid.

[40] Ibid.

[41] Charles Dickens, *Hard Times* (Leipzig, Elibron classics, 2006). See end of Chapter 9.

[42] Although most typically found in cases of amputation, there are also phantom limb cases in people born without limbs. This suggests that the phenomenon has something to do with feedback problems in different maps, and that whilst most commonly these maps are constructed through practical activity, Ramachandran suggests that there are also some maps ‘hardwired’ into the brain. Other explanations would be in these cases that other ‘full body’ maps are imported through processes of empathy with other bodies via mirror neurons, or even perhaps through Sheldrake’s concept of “morphic resonance”?

[43] Lord Nelson as quoted in Ramachandran and Blakeslee, *Phantoms in the Brain,* p.22.

[44] Ibid., p.29.

[45] It is worth noting that prior to Ramachndran’s experiments on the role that body maps played in this condition, the mainstream response had been to work on the basis that there was a physical neurological failure, and would experiment with further amputations, try to severe nerve connections etc – which would often just make the problem worse.

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[46] Although it is beyond the scope of this work here, I am now working on some future research projects exploring and theorising mirrors further.

[47] He further notes a case of a lower leg amputee who reported that his phantom limb took the form of a massively increased sense of “phantom arousal” and orgasm.

[48] See, for example, the work of Bud Craig, whose research into interoception mapping in relation to other maps is increasingly widely seen as the first strong explanation in terms of western medicine of why some alternative and eastern medical practices work. Craig argues that many disorders arise from mapping problems in the autonomic nervous system (with bad maps literally producing physical illnesses), and that alternative medicine techniques such as acupuncture and meditation can be explained as driven by re-mapping. More broadly, this research discusses how experiences based in tai chi, yoga, energy therapy etc are too extensive to be dismissed, yet no actual detectable energy fields have been found. Perhaps then, these practices are working with cognitive maps, that is to say, with peripersonal, body and space maps, and their interrelations, thereby creating real changes and experiences. See for example AD (Bud) Craig, ‘Interoception: the sense of the physiological condition of the body’, *Current Opinion in Neurobiology* 2003, 13, pp. 500-505, and Hugo D Critchley, Stefan Weins, Pia Rotshtein, Arne Ohman, Raymond Dolan, ‘Neural systems supporting interoceptive awareness’, *Nature Neuroscience* 7 (2004), pp.189-95.

[49] I met Henrik Ehrsson at the ‘Towards a Science of Consciousness’ conference in Tucson, Arizona in April 2010. He – like some other neuropsychologists present – was interested in the architectural readings that I was making out of their material, and has agreed to support a joint funding bid for an installation proposal that I have developed, which is to explore a variation of the rubber hand illusion at the scale of a building!

[50] Ramachandran and Blakeslee, *Phantoms in the Brain,* p.59.

[51] Sandra Blakeslee in conversation with Ginger Campbell (Brain Science Podcast): “And so, you see this motion and you feel this motion, and then you leave your body. You move out of your body toward the virtual reality representation of your body. It’s a dissociation.” My thesis here is that this dissociation, or alienation, is closely related to the aesthetic experience of spatial empathy as a ‘dissociative’ experience’.

[52] Olaf Blanke is a neurologist at Ecole Polytechnique in Lausanne, Switzerland who also published with the team working on VR based out of body projection.

[53] See for example Michael M Persinger, ‘The neuropsychiatry of paranormal experiences’, *Neuropsychiatric Practice and Opinion*, Vol. 13, No. 4 (2001), pp.521–22.

[54] Although apparently this failed on Richard Dawkins when tried!

[55] See for example, Bigna Lenggenhager, Tej Tadi, Thomas Metzinger and Olaf Blanke, ‘Video Ergo Sum: Manipulating Bodily Self-Consciousness’ in *Science* (vol. 317. no. 58414 August 2007), pp.1096-1099. Their synopsis states that:
“Humans normally experience the conscious self as localized within their bodily borders. This spatial unity may break down in certain neurological conditions such as out-of-body experiences, leading to a striking disturbance of bodily self-consciousness. On the basis of these clinical data, we designed an experiment that uses conflicting visual-somatosensory input in virtual reality to disrupt the spatial unity between the self and the body. We found that during multisensory conflict, participants felt as if a virtual body seen in front of them was their own body and mislocalized themselves toward the virtual body, to a position outside their bodily borders. Our results indicate that spatial unity and bodily self-consciousness can be studied experimentally and are based on multisensory and cognitive processing of bodily information.” (p.1069)

[56] Olaf Blanke and Shahar Arzy, ‘The Out-of-Body Experience: Disturbed Self-Processing at the Temporo-Parietal Junction’, in *Neuroscientist,* Vol 11 No.1 (2005) pp.16–24.

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[57] There are numerous accounts of soldiers who have risen above the battlefield they are in, and see their positions and those of others, and claim that this saved their lives. There are many accounts of athletes who have had OBEs in Michael Murphy and Rhea A White, *In the Zone - Transcendental Experience in Sport* (NY NY: Penguin Arkana, 1995), such as the long-distance swimmer who claimed that whenever he was exhausted while swimming he would recharge by floating above his swimming body for a while! There are of course vast numbers of reported cases of OBEs from people in altered states of consciousness such as meditation and shamanism. Researchers scanning the brains of Buddhist Monks have shown that activity in their parietal lobes (normal body maps) decreases dramatically during meditation. OBEs are a frequent component of near-death experience, and have been documented by Pim van Lommel in The Lancet (van Lommel P, van Wees R, Meyers V, Elfferich I. 'Near-Death Experience in Survivors of Cardiac Arrest: A prospective Study in the Netherlands', in *Lancet*, December 15, 2001,pp.2039–45.) It is probably the near-death experiences and OBEs in patients who are on record as having no brain activity, that is currently the biggest challenge to the thesis that consciousness requires a brain: "there is a well documented report of a patient with constant registration of the EEG during cerebral surgery for an gigantic cerebral aneurysm at the base of the brain, operated with a body temperature between 10 and 15 degrees, she was put on the heart-lung machine, with VF, with all blood drained from her head, with a flat line EEG, with clicking devices in both ears, with eyes taped shut, and this patient experienced an NDE with an out-of-body experience, and all details she perceived and heard could later be verified." (Pim van Lommel, 'A Reply to Shermer - Medical Evidence for NDEs' in *Skeptical Investigations*, accessed on 1.7.09 at http://www.skepticalinvestigations.org/whoswho/vanLommel.htm) In this regard a three year experimental programme started in 2008 run by Dr Sam Parnia of the Human Consciousness Project. The experiment consists of a series of images that have been places at high level out of view in operating theatres and the like, in several university hospitals in Europe and the USA, which can only be seen from the ceiling.

[58] Blanke's research suggest that in the case of his patients with electrically-induced out-of-body experiences, although their experiential account is of a coherent visual field from a position near the ceiling, when questioned about details, they do not seem to be able to clearly see anything that cannot be seen from their position in the hospital bed. This suggests that their feeling of being pressed against the ceiling might be a projection of the sensation of their back on the bed, and that the rest of the scene is filled in by their brain, using a combination of visual and non visual clues perhaps. In this sense, even the "battlefield" type projections (mentioned in footnote above) might be based upon the brain actually assimilating auditory or other clues as to "enemy locations" but which are typically unavailable to consciousness, but which in an emergency situation it organises into a useful holistic representation through the adoption of an out-of-body projection viewpoint. This suggests, in accordance with much current research, that an enormous amount of what we think of as "vision" is actually produced or imagined by the visual cortex. For a discussion of the construction of vision in this sense, see Ramachandran op. cit. pp 96-103. Particularly interesting is the account of the patient called Josh, who suffered from a large scotoma (hole) in his retina, but of which he was not normally aware. However, Ramachandran devised experiments whereby Josh was able to watch his visual cortex filling in patterns in real time. There is also much interesting work produced by Beau Lotto's LottoLab regarding the construction of visual experience.

[59] Ramachandran and Blakeslee, *Phantoms in the Brain,* p.61-62.

[60] Andy Clark, 'Soft Selves and Ecological Control', in Don Ross, David Spurrett, Harold Kincaid and G. Lynn Stephens (eds.) *Distributed Cognition and Will - Individual Volition and Social Context* (Cambridge MA: MIT, 2007), p.114.

[61] Some connectionist accounts of the extended mind thesis tend to oversimplify this, and devolve all cognitive faculties out in ways that do not seem to fully account for experience.

[62] For Bateson's discussion of maps, difference and information, see Gregory Bateson, 'Form, Substance and Difference' in *Steps to an Ecology of Mind* (Chicago: University of Chicago Press, 2000), p.454-71.

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[63] It seems that it had been thought – in the sciences, if not in the humanities – that we mapped space as a single field. However, as Rizzolatti makes clear, “far from taking the form of a unitary map, the cortical representation of space in both humans and monkeys appears to be based on the activation of distinct sensory-motor circuits, each of which organises and controls motor acts (such as reaching) that require objects to be specifically located with respect to a given body part (hand, mouth, eyes etc.).. the presence in both neural circuits [f4-VIP and F5 -AIP] of visual responses connected to motor activation suggests that what is true for objects is equally true for space.” Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.66.

[64] Michael Grazino and Charles Gross at Princeton University, found that each part of the body has its own spatial map, with local co-ordinates of a bubble of potential action space attached. There are also similar maps for sounds around the body.

[65] Rizzolatti notes that infants up to three months old can only see 20 cm in front of them, and refers to Jean Piaget observation that in this period infants spent much time watching their hands. He ascribes this to “calibrating peripersonal space in addition to that of measuring object sizes according to their graspability.” Rizzolatti and Sinigaglia, *Mirrors in the Brain*, p.71.

[66] According to Blakeslee, “your self does not end where your flesh ends, but suffuses and blends with the world, including other beings. Thus when you ride a horse with confidence and skill, your body maps and the horse’s maps are blended in a shared space.” Blakeslee and Blakeslee, *The Body Has a Mind of Its Own*, p.3.

[67] Ibid., p.5.

[68] Ibid., p.136.

[69] Rizzolatti and Sinigaglia, *Mirrors in the Brain*, p.55.

[70] There are three different types or ‘modalities’ of neurons involved in these proceses. Basic somatosensory neurons, somatosensory and visual neurons (bimodal), and somatosensory and visual and auditory neurons (trimodal.) For Rizzolatti, “the most interesting functional aspect of f4 bimodal neurons is that they respond to visual stimuli only when these appear in the vicinity of their tactile receptive field; more precisely, within that specific space portion which represents their visual receptive field and appears to constitute an extension of their somasensory receptive field.” Rizzolatti and Sinigaglia, *Mirrors in the Brain*, p.54-5.

[71] Eric R. Kandel , *Psychiatry, Psychoanalysis, and the New Biology of Mind* (Washington, D.C.: American Psychiatric Publishing, 2005) p.296.

[72] Theodore Adorno, ‘Functionalism Today’ in Neil Leach (ed.), *Rethinking Architecture - A reader in cultural theory* (London: Routledge, 1997), p.17.

[73] See http://www.brain.riken.jp/en/a_iriki.html

[74] Increasingly, it seems that there is agreement with the thesis first proposed by Engels in his essay on ‘The Part played by Labour in the Transition from Ape to Man,’ Stephen Jay Gould has stated that had Engels’ essay been more favourably disseminated, a century of work might have been advanced.

[75] Clark, ‘Soft Selves and Ecological Control’, p.101.

[76] Ibid., p.111.

[77] See Marqand Smith, ‘The Uncertainty of Placing: Prosthetic Bodies, Sculptural Design, and Unhomely Dwelling in Marc Quinn, James Gillingham, and Sigmund Freud’, in *Phantom Limb: A Neurobiological Diagnosis with Aesthetic, Cultural and Philosophical Implications* (2004), published online at http://www.artbrain.org/category/journal-neuro-aesthetic-theory/phantom-limb/

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[78] At least, not at the classical level – it is certainly not completely implausible that macrocosmic systems produce real fields at a quantum scale, supported by non-local quantum effects (of the kind suggested by the work associated with Stuart Hameroff for example) or a more basic fundamental interconnectedness of matter-field processes in the way proposed by David Bohm for example, but that does not concern us here directly.

[79] There are all kinds of results that claim to challenge that. See, for example, Rupert Sheldrake,*The Sense of Being Stared At, and other aspects of the Extended Mind* (London: Arrow, 2003).

[80] For a discussion of this see Blakeslee and Blakeslee, *The Body Has a Mind of Its Own*, p. 120-21.

[81] Ibid., p.134.

[82] According to Peter Harries-Jones, *A Recursive Vision: Ecological Understanding and Gregory Bateson* (Toronto: University of Toronto Press, 1995), p.49.

[83] One exception to this is Reyner Banham's 'well-tempered environment' proposal with Francois Dallegret, where we do find a larger collective bubble, containing a group of individuals and with some media technology.

[84] Referred to in Rizzolatti and Sinigaglia, *Mirrors in the Brain,* pp.62-74.

[85] Ibid., p.67 (contains a quote from Ernst Mach's 1905 paper, 'Knowledge and Error').

[86] J.J. Gibson, cited in Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.34.

[87] Ramachandran tells of a patient whose phantom hand would automatically respond to nearby affordances, and reach out and "hold" cups etc. He even felt pain if a cup was picked up by someone else, as if it was snatched from his hand! See Ramachandran and Blakeslee, *Phantoms in the Brain,* p.43.

[88] Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.34.

[89] Bruno Latour, *Reassembling the Social - An Introduction to Actor-Network-Theory* (Oxford: OUP, 2007) p.72

[90] Maurice Merleau-Ponty, *Phenomenology of Perception* (1945) p.162, as cited in Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.52.

[91] Ibid., p.51.

[92] Of course, many natural environments too would have provided highly complex spatial structures, and in many ways human construction would have provided a somewhat abstracted and simplified foil to the complexity of natural environments. Again, one wonders if there is a relative simplicity to the spatial morphology of the desert that might allow an experience of peripersonal space fields to come to the fore in Himba consciousness. Equally, I wonder whether our assumptions that the metropolitan condition is one of intensified nervous stimulation is always the case. Even when taking into account the wildness of modern media, for many inhabitants the city might still represent a form of sensory deprivation, compared to the spatial richness that a life more engaged with a living landscape might offer.

[93] I think that my insight here that a development of Gibson's concept of affordance offers a way to re-theorise architectural pattern and decoration is important, and I plan to explore this further in future research.

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[94] The quote is as follows: “the [motor] system is composed of a mosaic of frontal and parietal areas that are very closely linked to the visual, auditory and tactile areas... [and] is also endowed with functional properties that are much more complex than was previously thought... there are neurons that become active in response to goal-directed motor acts (such as grasping, holding, manipulating, etc.) and not just to simple movements; not only, they also respond selectively to the shapes and sizes of objects both when we interact with them and also when we just observe them. These neurons appear to be able to discriminate sensorial information, coding it on the basis of the range of potential acts offered, independently of whether they subsequently evolve into a concrete action.” Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.x-xi.

[95] Rizzolatti and Sinigaglia, *Mirrors in the Brain,* p.xii.

[96] Ibid., p.xiii.

[97] See Edvard I. Moser, Emilio Kropff, and May-Britt Moser, ‘Place Cells, Grid Cells, and the Brain's Spatial Representation System’ in *Annual Review of Neuroscience*, Vol. 31, 2008: pp. 69-89. For a broad seminal survey of the role that the hippocampus plays in spatial awareness and cognitive mapping, see John O'Keefe and Lynn Nadel, *The Hippocampus as a Cognitive Map* (Oxford: OUP, 1978). This is available online at http://www.cognitivemap.net

[98] Discovered in 1971 by John O’Keefe and John Dostrovsky. See also recent work at UCL by Hugo Spiers (http://www.ucl.ac.uk/spierslab/).

[99] See Kathryn J. Jeffery, ‘Integration of the Sensory Inputs to Place Cells: What, Where, Why, and How?’, in *Hippocampus* No.17 (2007) p.777.

[100] It is presumed that the geometry of grid cells is based upon the mathematics of hexagonal close packing (a geometry that occurs frequently in both the brain and natural organisation). It is easy to derive an orthogonal grid from a hexagonal grid, by just joining every other row/column.

[101] For a discussion of the relations between place, grid and head direction cells see Kathryn J. Jeffery, ‘Integration of the Sensory Inputs to Place Cells: What, Where, Why, and How?’, in *Hippocampus,* No.17, (2007) p.775-85.

[102] See Eleanor A. Maguire, David G. Gadian, Ingrid S. Johnsrude, Catriona D. Good, John Ashburner, Richard S. J. Frackowiak, and Christopher D. Frith, ‘Navigation-related structural change in the hippocampi of taxi drivers’ in *PNAS (Proceedings of the National Academy of Sciences)* Vol. 97, No. 8 (2000) pp.4398–403.

[103] See Eichenbaum H, Dudchenko P, Wood E, Shapiro M, Tanila H, ‘The hippocampus, memory, and place cells: is it spatial memory or a memory space?’, *Neuron,* No. 23 (1999), pp.209 –26.

[104] Dharshan Kumaran and Eleanor A. Maguire, ‘The Human Hippocampus: Cognitive Maps or Relational Memory?’, *The Journal of Neuroscience*, No. 25, Vol. 31 (2005) pp.7254 –259.

[105] Humberto Maturana and Fransisco J. Varela, *Autopoiesis and Cognition* (Dordrecht, Holland: D. Reidel, 1980), p.34.

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[106] This argument was first advanced in J.D Lewis-Williams and T.A. Dowson, 'The signs of all times: Entoptic Phenomena in Upper Palaeolithic Art', *Current Anthropology* 29 (1988), pp.201-45. Lewis-Williams makes two moves in this direction. Firstly, drawing upon work by cognitive psychologist Colin Martindale (See Colin Martindale, *Cognition and Consciousness* (Homewood, Illinois: Dorsey Press, 1981)), Lewis-Williams argues that "need to think of consciousness not as a state, but as a continuum or spectrum." (David Lewis-Williams *The Mind in the Cave - Consciousness and the Origins of Art* (London: Thames and Hudson, 2002). p.122.) Secondly, he argues that the range of human conscious experience was extended and intensified through psychoactive plant ingestion.

For Martindale, the spectrum of consciousness ranges through waking (various problem oriented thought levels), realistic fantasy, autistic fantasy, reverie, hypnagogic (falling asleep states), dreaming (various states), and finally a total absence of consciousness.

Consciousness, is indeed, as Charles Laughlin notes, a "fragmented" phenomenon. During day we typically shift between inward and outward oriented consciousness, normally based upon 90-120 min cycles (See C. Laughlin, D. McManus and E.G. d'Aquili, *Brain, Symbol and Experience: Towards a Neurophenomenology of Human Consciousness* (New York: Columbia University Press, 1992.) and more recently the excellent Jeff Warren, *Head Trip: A Fantastic Romp through 24 Hours in the Life of your Brain* (Oxford: One World, 2008). However, consciousness is also culturally and historically variable, and is socially produced. Different societies valorise the various forms of consciousness very differently. Some societies see inward states as pathological, whilst others see them as others divine. Within contemporary western society, different forms of consciousness are seen as more or less appropriate at different times and in different places. Commodity consumption relies upon high levels of non rational consciousness, and equally, at certain moments, the embracing of altered forms of consciousness has had political importance for certain groups. As William James has noted (quoted by Lewis-Williams), fully rational waking consciousness is just one form, "whilst all about it, parted by the flimsiest of screens, there lie the potential forms of consciousness, entirely different."

Lewis-Williams develops a discussion around consciousness partly in order to attack some of the theories advanced by evolutionary psychology. In particular he criticises Mithen's work (see Stephen Mithen, *The Prehistory of the Mind, A Search for the Origins of Art, Religion and Science* (London/New York: Thames and Hudson,1996)). In this work, Mithen draws upon modularity based models of mind (especially Jerry Fodor's account, and Nicholas Humphrey's "reflexive consciousness" theory of mind.) Lewis-Williams argues that what for Mithen et al is a "social intelligence module" is actually an emergent socio-systemic effect: "what today constitutes acceptable human consciousness - 'the consciousness of rationality' - is an historically situated notion constructed within a specific social context... it is not simply a function of interacting intelligences" (Lewis-Williams, *The Mind in the Cave,* p.121.) He argues that evolutionary psychology is based on an assumptions that intelligence is primarily rational, and that evolution is a process leading "people to become more and more like western scientists!" (Lewis-Williams, *The Mind in the Cave,* p.111).

[107] See, for example, Paul C. Bressloff and Jack D. Cowan, 'Spontaneous pattern formation in primary visual cortex', in S. J. Hogan, A. Champneys and B. Krauskopf (eds.) *Nonlinear dynamics: where do we go from here?* (Bristol: Institute of Physics, 2002), pp.269-320.

[108] Lewis-Williams, *The Mind in the Cave,* p.127.

[109] Jeff Hawkins interviewed by Ginger Campbell for Brain Science Podcast, accessed on 4.5.10 from accessed from http://docartemis.com/brain%20science/38-JeffHawkins-OnIntelligence.pdf.

[110] Mark Wigley, 'Recycling Recycling' in Amerigo Marras (ed.), *Eco-Tec, Architecture of the In-Between* (NY: Princeton Architectural Press, 1999) p. 46

[111] Lars Spuybroek, 'Motor Geometry', in Stephen Perrella (ed.) *AD Hypersurface Architecture* (London: Wiley, 1998),p.49.

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[1] Some sections of this chapter were first given as a paper at the 'Material Matters' conference at the University of East London in 2005, and a version was then published as an essay in the book that followed of the same name, edited by Katie Lloyd Thomas, as 'Marx Matters'. The text here, however, has been substantially edited, extended and amended, and contains many more images that the 'Material Matters' chapter, and in that respect is closer to the original lecture. The main changes in those sections, as far as content is concerned have been to reduce the overstated emphasis that was given in the original text to the influence of German Orientalism. In the original, I often described ideas as manifesting an "orientalist cosmology", when what I wanted to emphasise was the presence of explicit or underlying panpsychic and systemic models of matter. See Jon Goodbun, 'Marx Matters, or Aesthetics, Technology, and the Spirit of Matter', in Katie Lloyd Thomas (ed.), *Material Matters: Architecture and Material Practice* (London: Routledge, 2007), pp.67-78.

[2] Gregory Bateson, Box 6 Manuscripts 'Mind in Nature', 17 November 1977 (unpublished), quoted in Peter Harries-Jones, "Gregory Bateson's 'Uncovery' of Ecological Aesthetics" in Hoffmeyer (ed.), *A Legacy for Living Systems*, p.158. There is a published though slightly different version of this in Gregory Bateson, *Mind and Nature*, p.10.

[3] *Collins English Dictionary*, accessed on 1.7.08 at http://www.collinslanguage.com/

[4] Titchener states: "Not only do I see gravity and modesty and pride and courtesy and stateliness, but I feel
or act them in the mind's muscles. This is, I suppose, a simple case of empathy, if we may coin that term as a rendering of *Einfühlung*." Edward B. Titchener, *Lectures on the Experimental Psychology of Thought Processes* (New York: Macmillan, 1909), pp.21–22.

[5] Lipps produced one of what Adrian Forty describes as "three remarkable essays [which] appeared almost simultaneously – and apparently independently of each other – in the year 1893." Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), p. 259. The other two authors were Adolf Hilderbrand and August Schmarsow. Each of these essays synthesised in new ways the ideas of empathy, form and space.

[6] "The term emerged in roughly its current sense during the seventeenth century in English, French, and German. Initially, its meaning was wider, referring to some kind of affinity between not only people but also things. The latter related chiefly to a medical context, such as the "sympathy" regarded as linking a medicament with a specific disease (e.g., Digby, 1669), or different parts of the body, or people when illnesses were said to be passed on "sympathetically" (Whytt, 1765). The psychological meaning of sharing the feelings of another person or being affected by their suffering existed in parallel. An early example is cited in the *Oxford English Dictionary*: "Out of faithful and true simpathy [sic] and fellow-feeling with you" (1662)."
Gustav Jahoda, 'Theodor Lipps and the shift from "sympathy" to "empathy"', *Journal of the History of the Behavioural Sciences* Vol. 41, No. 2 (2005), p.152.

[7] See Joseph Rykvert, 'Organic and Mechanical', in Wiliam W. Braham and Jonathan Hale with John Stanislav Sadar (eds.) *Rethinking Technology - A Reader in Architectural Theory* (London and New York: Routledge, 2007), pp.337-49.

[8] Quoted by Melvin M Rader, *A Modern Book of Esthetics* (New York: Henry Holt, 1935), p.287.

[9] Goethe's posthumous editor, Rudolf Steiner, set out in books such as *Goethean Science* (1897) and *The Theory of Knowledge Implicit in Goethe's World Conception* (1886), what remain some of the clearest instructions about how to consciously empathise with objects – however problematic Steiner's thought might be in some other regards. More recently, there has been a revival of interest in the possibility of a Goethean Science, largely in relation to Gaia Theory, with scientists such as Stephan Harding, Stephen Harold Buhner and Henri Bortoft using and describing empathy-like methods as a way of holistically describing natural systems. Harding's work is particularly useful I think – see Stephan Harding, *Animate Earth: Science, Intuition and Gaia* (White River Jct., Vermont: Chelsea Green Publishing, 2007). There is no small relation between Bateson's ecological aesthetic project and Goethe's holistic science, and this has been explored to some extent in the recent publication: Noel G Charlton, *Understanding Gregory Bateson: Mind, Beauty and Sacred Earth* (New York: State University of New York Press, 2008).

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[10] G.W. Pigman, 'Freud And The History Of Empathy', *International Journal of Psycho-Analysis,* 76 (1995), pp. 237-56. Pigman notes that in the English Standard Edition of Freud's work, however, *Einfühlung* is not consistently translated as *empathy*.

[11] The correspondence between the concepts of empathy and mimesis is made clear by Lakoff and Johnson, who state that "in preparing to imitate, we empathically imagine ourselves into the body of another ... cognitively simulating the movements of the other ... which results in the 'feel' of movement without moving. The experience of such a 'feel' is a form of empathic projection. There is nothing mystical about it. It is what we do when we imitate. Yet this most common of experiences is a form of 'transcendence', a form of being in the other." George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought* (New York: Basic Books, 1999), p.565.

[12] Theodor Adorno, 'Functionalism Today', in Neil Leach (ed.), *Rethinking Architecture: A reader in cultural theory* (London: Routledge, 1997), p.9.

[13] See, for example, Neil Leach, 'Mimesis*', Architectural Theory Review,* Vol. 10, No. 1 (April 2005), pp. 93-104; and Neil Leach, *Forget Heidegger* (Bucharest: Paideia, 2006). In the latter, Leach makes many statements along the lines of: "For Adorno ... mimesis overcomes the alienation of conceptual thought, and offers an alternative, more empathetic model of human interaction" (p.80). An extension of empathy into mimesis offers more clearly a way to conceive of what in Chapter Five was noted as the difference between kinaesthetic and iconographic, or connectivist (emergent) and computational (symbolic) meaning: "mimesis … allows one to forge a symbolic relationship with one's environment. Mimesis may help to explain how we identify progressively with our surroundings in general. We read ourselves into our surroundings ... The subject creatively identifies with the object, so that the object ... is appropriated as part of the symbolic background through which individuals constitute their identity" (pp.82-83).

[14] Pigman, 'Freud And The History Of Empathy,' pp.237-256.

[15] Evan Thompson, *Mind in Life: Biology, Phenomenology and the Sciences of Mind* (Cambridge, MA: Belknap Press of Harvard University Press, 2007), p.382.

[16] Herman Lotze, *Microcosmos: An Essay concerning Man and his Relation to the World*, trans. E. Hamilton and E. E. Constance Jones (New York: Scriber and Welford, 1886), p.584.

[17] Cornelis van de Ven, *Space in Architecture: The Evolution of a New Idea in the Theory and History of the Modern Movements*, (Assen/Amsterdam: Van Gorcum, 1978).

[18] Mitchell W. Schwarzer, 'The Emergence of Architectural Space: August Schmarsow's Theory of Raumgestaltung', *Assemblage,* Vol.15 (1991), pp.48-61.

[19] The draft of Forty's chapter (and the research leading to it) was a key course component in his History of Modern Architecture masters course at the Bartlett. A reconsideration of these texts also became increasingly important in some architectural research more broadly. Writing in 1999, Anthony Vidler for example notes that: "The return to Simmel has been paralleled in art and architectural history by a rereading of the founding texts of spatial analysis in architecture – Wölfflin, Riegl, Schmarsow, Hildebrand, Göller – as part of a new critical historiography of the discipline. Margaret Iverson on Riegl, Mitchell Schwarzer on Schmarsow, and the anthology of texts assembled and introduced by Harry Mallgrave and Eleftherios Ikonomou have contributed to a history of approaches that is not only much needed in architectural history but also forms part of the intellectual and cultural history of modern architecture itself. Their work thus complements from the point of view of architecture the comprehensive survey of modernist spatial ideas in art begun by Linda Dalrymple Henderson in 1983. The question of space, fully historicized, has been tackled in only a few recent monographs..." Anthony Vidler, 'Technologies of Space/Spaces of Technology', *Journal of the Society of Architectural Historians* Vol. 58, No. 3 (Sep., 1999), pp.482-86.

[20] Although it is worth noting that, for Adrian Forty, form has now "outlived its usefulness ... become frozen, no longer in active development, and with little curiosity to what purposes it might serve." Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), p.172.

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[21] See, for example, Kari Jormakka, *Flying Dutchmen: Motion in Architecture* (Berlin: Birkhaüser, 2002). See also my own teaching-based research on ‘Dancing with the Machines’ in Chapter Three.

[22] Le Corbusier, *Engineers Aesthetic and Architecture*, in Braham and Hale with Sadar (eds.) *Rethinking Technology,* p.33.

[23] Beyond the panpsychist ingredients that I propose here, van der Ven suggests all kinds of other references that further support such an interpretation. For example, his first chapter notes the resonance between space and Lao-Tzu’s Taoist philosophy, and more broadly he shares Max Jammer’s suggestion that since the middle ages, via cabalistic thought, there has been an association between god and space. See Max Jammer, *Concepts of Space* (New York: Dover, 1993; originally published 1954).

[24] Forty, *Words and Buildings*, p.256.

[25] Both published their initial papers on space in 1893, and both of which are in the Mallgrave and Ikonomou collection.

[26] August Schmarsow, ‘The Essence of Architectural Creation’, in Harry Mallgrave and Eleftherios Ikonomou (eds.), *Empathy, Form, Space: Problems in German Aesthetics 1873-1893* (Santa Monica, CA: Getty Centre, 1994), p.296.

[27] van der Ven, *Space in Architecture*, p. xiv.

[28] This aspect of Adolf Loos’ essay on ‘Ornament and Crime’ is often overlooked. He is not simply saying that ornament is wrong, as much as he is saying meaningful symbolic public ornament is *impossible* in a multicultural metropolitan condition, where there is no ‘organic’ shared language, in the way in which there is in a vernacular or classical condition. Whether we accept that statement is another matter of course, and advertising certainly seems to be able to find common public languages, as Venturi has frequently observed (even if he himself is less able to successfully prove it is possible still in architecture!). Perhaps a more compelling route out of this dilemma, certainly from a modern spatial empathy position, is a possibility that emerges from Kracauer’s conception of *The Mass Ornament*. See Sigfried Kracauer, *The Mass Ornament: Weimar Essays*, trans Thomas Y Levin (Cambridge, MA: Harvard University Press, 1995). Here, it is suggested that it is possible to trace ‘patterns that connect’ between in this instance a kind of rhythm-analysis of the spatial practices of the Tiller Girls’ dance group and repetitive mechanised factory labour. In a closely related sense, Charlotte Klonk has suggested that “the art of ornamentation was promoted by many members of European reform movements, from the Belgian Henry van de Velde to Josef Hoffmann in Austria and August Endell in Germany, precisely in order to reach the modern soul directly and effectively. Attention to the principles of abstract pattern-making was intended to attune the sensations of city dwellers in a way that would be appropriate to the pace of modern urban life.” Charlotte Klonk, ‘Patterns of Attention: from shop windows to gallery rooms in early twentieth century Berlin’, *Art History,* Vol 28 No 4 (September 2005), p.469.

[29] This aspect of its origins has not been written about on the whole. The classic treatment of empathy describes this discourse as being based in Kantian aesthetics (which is no doubt in part accurate). However, other contemporary researchers in this area have reacted favourably to my position in this regard. Notably, Susan Lanzoni (Visiting Scholar on the Science Technology and Society Program at MIT) in correspondence wrote: “although I haven't focused on the Hegelian connection to empathy, I always thought there was something in the objectification of spirit that seems consonant with an understanding of empathy. I ... see that there is certainly a fruitful resonance between Marx's notion of commodity and *Einfühlung* theory as put forth by Vischer and Schmarsow ... I like the emphasis on the continuing presence of the theological, or the pantheistic in your paper. The question of presence or projection is key, I think.” (email correspondence with author 28th January 2009). Lanzoni was one of the organisers of an invited workshop ‘Varieties of Empathy in Science, Art and Culture‘ held at the University of British Columbia, in October 2008, which brought together cognitive science theorists such as Shaun Gallagher and Evan Thompson (both of whom I have referred to in other chapters here) with empathy scholars from psychology and aesthetics (including Harry Mallgrave), to discuss the implications of mirror neuron research. Although somewhat frustratingly, as I had by this time independently made the same connections, it was useful to see these thoughts confirmed by others.

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[30] Harry Mallgrave and Eleftherios Ikonomou have in particular promoted this interpretation, stating for example that “it was Immanuel Kant (1724-1804) who provided the paradigm for the German philosophical treatment of form and space in the nineteenth century.” Harry Mallgrave and Eleftherios Ikonomou, ‘Introduction’, in Mallgrave and Ikonomou (eds.), *Empathy, Form, Space*, p. 5.

[31] I suspect that the repeated comments that this is a Kantian aesthetics is based upon the many statements by, for example, Schmarsow regarding an ‘intuited sense of space’. The obvious association is to Kant, for whom space was indeed an internal mental intuition. However, I am not at all convinced that Kant would have recognised Schmarsow as talking about the same kind of thing. For a start, space for Kant was not an aesthetic category, and secondly, the kind of intuition that Schmarsow describes is a thoroughly embodied one, produced by the active body. This seems very different to Kant’s conception of spatial intuition.

[32] Heinrich Heine, *Religion and Philosophy in Germany*, trans. John Snodgrass (Boston: Beacon Press, 1959), p.79.

[33] Forty, *Words and Buildings*, p.258.

[34] Mallgrave and Ikonomou ‘Introduction’, p.5.

[35] Other prominent Young Hegelians (also known as Left Hegelians, though they called themselves the Doctors Club) included the brothers, Bruno and Edgar Bauer, David Strauss and Max Stirner.

[36] According to Mikhail Lifshitz, *The Philosophy of Art of Karl Marx* (1933), trans. Ralph B Winn (London: Pluto, 1973). Lifshitz notes on p. 83 for example that Marx’s notebooks from 1857-58 contain a detailed synopsis of F.T. Vischer’s *Aesthetiks*.

[37] From Karl Marx’s doctoral dissertation, *The Difference Between the Democritean and Epicurean Philosophies of Nature*, written between 1839 and 1841; excerpt published as ‘To Make the World Philosophical’ in Robert C Tucker (ed.), *The Marx-Engels Reader Second Edition* (New York: W W Norton and Co., 1978), pp.9-11.

[38] William J Brazill, *The Young Hegelians*, (London: Yale, 1970), p.172.

[39] Georg Hegel, quoted ibid.

[40] van de Ven, *Space in Architecture*, p.80.

[41] F.T. Vischer directly anticipated the concept of empathy, which he described as a process of emotional identification. Furthermore, other empathy theorists were studying this work. Heinrich Wölfflin in particular repeatedly quotes from F.T. Vischer’s Aesthetic’s in his *Prologomena to a Psychology of Architecture*. In fact, Wölfflin identifies some very interesting formulations from F.T. Vischer regarding a dialectical account of whole/part relations (interesting here in regard to my discussion of organicism and emergence in Chapter Two and Chapter Four respectively). For example, he notes “the last and most mysterious element of form is *harmony*, ‘the vital and animated unity of the inner vital force’: ’It unifies the parts, for it is the parts’ (Vischer). We find the concept of harmony best defined in morphology by the notion of the organism.” Heinrich Wölfflin, ‘Prologomena to a Psychology of Architecture’, in Mallgrave and Ikonomou (eds.), *Empathy, Form, Space*, p.166.

[42] Robert Vischer, ‘On the Optical Sense of Form: A Contribution to Aesthetics’ in Mallgrave and Ikonomou (eds.), *Empathy, Form, Space*, p.111.

[43] Ibid., p.97.

[44] Ibid., p.96.

[45] Ibid. p.104.

[46] Ibid., p.111.

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[47] Karl Marx, *Grundrisse: Foundations for the Critique of Political Economy (Rough Draft)*, trans. Martin Nicolaus (Harmondsworth: Penguin, 1973), p.92.

[48] Karl Marx, *Notebooks*, cited in Lifshitz, *The Philosophy of Art of Karl Marx*, p.95.

[49] Ibid., p.83.

[50] Ibid., p.96.

[51] Karl Marx, 'Economic and Philosophic Manuscripts of 1844', in Tucker (ed.), *The Marx-Engels Reader*, p.88.

[52] Ibid.

[53] Ibid.

[54] Schmarsow, 'The Essence of Architectural Creation', p.294.

[55] Marx, *Notebooks*, p.78.

[56] Marx, 'Economic and Philosophic Manuscripts of 1844', p.87.

[57] Ibid., p.89.

[58] Karl Marx, *Capital: A Critique of Political Economy Volume 1* (London: Penguin, 1990), p.163.

[59] Ibid., p.164

[60] Terry Eagleton, *The Ideology of the Aesthetic* (Oxford: Basil Blackwell, 1990), p.208.

[61] Wölfflin, 'Prologomena to a Psychology of Architecture', pp.157-58.

[62] Heinrich Wölfflin, *Renaissance and Baroque* (Ithaca, NY.:Cornell University Press, 1966), p.78.

[63] Mark Wigley, 'Network Fever', in *Grey Room 04*, (Cambridge, MA: MIT, Summer 2001) pp. 82-122.

[64] Karl Marx, *Capital*, pp. 493-94, footnote.

[65] Marshall McLuhan, Interview in *Playboy*, March 1969

[66] Roy Ascott, 'Syncretic Fields: Art, Mind and the Many Realities', lecture given on April 30, 2007, at Design Media Arts, UCLA. See Streaming Culture lecture series, accessed on 14.5.09 at http://dma.ucla.edu/events/calendar.php?ID=469

[67] David Greene, 'LAWUN Project No.2: The Invisible University', in *A Guide to Archigram 1961-74* (London: Academy, 1994), p.365.

[68] In the last decade, a new generation of interface artists such as Jason Bruges and Usman Haque have been producing installations and spaces which visualise the invisible networks and fields, both man-made and artificial, that surround us and our planet. Some of these artists have even been collaborating with David Greene, in particular on extensions to the LAWUN Invisible University project - for example the LAWUN Selfridges window display in 2004 (including work by Polytechnic student, Chris Gotsis).

[69] If Marx turned Hegel "back onto his feet", does that mean that for Marx architecture is the now the highest art – or is it still the lowest, but for different reasons?!

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[70] Hegel quoted in van de Ven, *Space in Architectur* , p.37. In many respects Hegel's comments were repeating many other observations that Gothic interior demonstrated a particular and distinct relation between metaphysics and space, and that in fact these interiors arguably initiated the architectural discussion around what would come to be called space. Most notable amongst these for van der Ven would be Witelo's thirteenth-century study of light, in which he discussed Gothic interiors, describing atmospheric qualities of "diaphanitas, densitas, obscuritas, umbria" in the 'Perspectiva Communis' of 1270 (which was quoted by both Alberti and da Vinci). Later, Abbot Suger of St Denis would unite building and metaphysics, in his own essay on light. Otto von Simson similarly suggested that the Gothic cathedral is a direct response to, or expression of, twelfth-century theological metaphysics, primarily based upon the Augustian belief in light as a manifestation of god. For a discussion around these references, see van de Ven, *Space in Architecture,* pp.21-24 in particular.

[71] At the Weimar Nietszche Forum in 2003, Slavoj Zizek described a condition of "Wall St Buddhism", which I am extending here to include the broad drift in management theory today, where a neo-Taoist model has been adopted. Commerce is basically seen as a primary manifestation of the tao chi – an all-pervading energy force.

[72] Georg Simmel, quoted in Henrik Reeh, *Ornaments of the Metropolis: Sigfried Kracauer and Modern Urban Culture*(Cambridge, MA: MIT Press, 2004), p. 32; referenced to 'Der Begriff und die Tragödie der Kultur' in Georg Simmel, *Das individuelle Gesetz,* ed. Michael Landmann (Frankfurt am Main: Surkamp Verlag, 1968), p.147.

[73] Although it has been beyond the scope of this study, it would be interesting to reflect further upon these questions with regard to two architectural theorists who have sought to develop a socio-spatial analysis out of architectural organisation and knowledge, but who have singularly 'side-stepped' any ideological analysis: Bill Hillier (as mentioned previously) and Christopher Alexander.

[74] Georg Simmel, 'Metropolis and Mental Life' in David Frisby and Mike Featherstone (eds.), *Simmel on Culture: Selected Writings* (London and Thousand Oaks, CA.: Sage, 1997) p.143.

[75] We might ask, what does that mean? How the does the metropolis – today a global entity – map onto the individual in any meaningful way. The answer to that is of course that, in this Batesonian sense, the "individual" mind really is the extended into the "metropolis", and co-extensive with it.

[76] Bruno Taut, *Modern Architecture* (London: The Studio, 1929), p.7.

[77] Forty, *Words and Buildings,* p.167.

[78] Adolf Behne, *The Modern Functional Building* (1926), trans. M. Robinson (Santa Monica: Getty Research Institute, 1996), p.137.

[79] It is not that it is wrong to see "social pattern". However, what we also need to see – which is extremely hard – is that we are also a "pattern" in ourselves, and furthermore a pattern that connects to the (in this case) social pattern through another pattern that connects. This can very easily become invisible, and the invisibility of the pattern that connects can be called 'ideology'!

[80] Forty, *Words and Buildings,* pp.171-72.

[81] Behne, *The Modern Functional Building*, p.137.

[82] Forty, *Words and Buildings*, p. 167.

[83] See, for example, Lyn Spillman (ed.), *Cultural Sociology* (London: Blackwell, 2002), p.37.

[84] Marshall McLuhan, *Understanding Media: The Extensions of Man* (London: Routledge, 2001 (originally 1964)), pp. 133-34.

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[85] McLuhan suggests in fact that we are entering a post-blasé period: "Western man acquired from the technology of literacy the power to act without reacting. The advantages of fragmenting himself in this way are seen in the case of the surgeon who would be quite helpless if he were to become humanly involved in his operation. We acquired the art of carrying out the most dangerous social operations with complete detachment. But our detachment was a posture of non-involvement. In the electric age, when our nervous system is technologically extended to involve us in the whole of mankind and to incorporate the whole of mankind in us, we necessarily participate, in depth, in the consequences of our every action. It is no longer possible to adopt the aloof and dissociated role of the literate Westerner." McLuhan, *Understanding Media*, pp.4-5.

[86] Alison and Peter Smithson, *Architectural Design* July 1969

[87] Schwarzer, 'The Emergence of Architectural Space: August Schmarsow's Theory of "Raumgestaltung"', p. 57.

[88] Fritjof Capra, *The Web of Life - A New Synthesis of Mind and Matter* (London: Flamingo 1996), p. 82.

[89] Georg Simmel, 'Metropolis and Mental Life', p.74.

[90] McLuhan, *Understanding Media*, p.4.

[91] Paul Ryan studied with both McLuhan and Bateson, and was involved in studying new media and film in particular, and was an important figure in the journal, *Radical Software*.

[92] McLuhan, *Understanding Media*, p.8. McLuhan continues, giving as examples: "The content of writing is speech, just as the written word is the content of print, and print the content of the telegraph." (ibid., p.8), and elsewhere, "the content of a movie is a novel or a play or an opera" (p. 19).

[93] Gregory Bateson, 'A Theory of Play and Fantasy', in *Steps to an Ecology of Mind* (Chicago: University of Chicago Press, 2000), pp.177-78.

[94] Ibid., p.188.

[95] McLuhan, *Understanding Media*, p.19.

[96] Ibid., p.133.

[97] Ibid., p.134.

[98] Marshall McLuhan and Quentin Fiore, *The Medium is the Massage: An Inventory of Effects* (New York: Random House, 1967), p.94-95.

[99] McLuhan, *Understanding Media*, p.5.

[100] van de Ven, *Space in Architecture*, p.39.

[101] See Catherine Ingraham, *Architecture, Animal, Human* (London: Routledge, 2006), p.16.

[102] Evan Thompson, 'Empathy and Consciousness' in *Journal of Consciousness Studies,* Vol. 8, Nos 5-7 (2001), p. 20.

[103] Ibid.

[104] George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought* (New York: Basic Books, 1999), p. 565.

[105] Ibid., p. 566

[106] Jonathan Hale, 'Cognitive Mapping: Rule or Model?', in *Culture, Theory and Critique,* Vol. 40, No.1 (1997), p.83.

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[107] Fredric Jameson, ‘Cognitive Mapping’, in Cary Nelson and Lawrence Grossberg (eds), *Marxism and the Interpretation of Culture* (Chicago: University of Illinois Press, 1990), p.353.

[108] McLuhan, *Understanding Media*, p.5.

[109] In some ways, the term “second nature” is highly problematic, in that can seem to reinforce a nature/culture dualism.

[110] Lakoff and Johnson also discuss empathic projection with animals, in particular in relation to shamanic practices.

[111] Gregory Bateson, ‘Pathologies of Epistemology’, in *Steps to an Ecology of Mind* , p.492.

[112] Indeed, as McLuhan again observed, "new media are not bridges between man and nature: they are nature." (Marshall McLuhan, *Counterblast* (London: Rapp and Whiting, 1969), p.14). Whilst he continues to warn that “literate man, once having accepted an analytic technology of fragmentation, is not nearly so accessible to cosmic patterns as tribal man,” (McLuhan, *Understanding Media*, p.134) it does seem to be the case that “today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned.” (McLuhan, *Understanding Media*, p.3).

[113] Manuel Castells, “Space of Flows, Space of Places”, in William B. Braham and Jonathan Hale, with Johan Stanislav Sadar (eds), *Rethinking Technology* (London and New York: Routledge, 2007), p.444.

[114] Manuel Castells, *The Rise of the Network Society, Vol 1: The Information Age* (Oxford: Blackwell, 1996), p.458.

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[1] Friedrich Engels, 'Anti-Dühring', in Karl Marx and Friedrich Engels, *Selected Works Vol 3* (1970) p.362.

[2] I owe this last observation to some comments made by Andreas Rumpfhuber at a EU HERA funded SCIBE (Scarcity and Creativity in the Built Environment) research group meeting hosted by the University of Westminster on 25-26 February 2011.

[3] Friedrich Engels, *Dialectics of Nature* (London: Wellred, 2007), p.63.

[4] This indeed is, I think, the way to take both Marx and Engels repeated statements that Marxism is a science. These comments are often left to the side in contemporary theory, seen as a perhaps embarrassing positivism that infected even these thinkers. There is of course something in that. However, I would encourage another reading: that their positing of Marxism as a science was intended to actually act to critique and expand what might be meant by science.

[5] Suggested by Maturana and Varela, and independently by Heinz von Foerster. Bruce Clark suggests that this defines second-order cybernetics.

[6] Pickering's interest group overlaps almost entirely with my own.

[7] Andrew Pickering, *The Cybernetic Brain - Sketches of Another Future* (Chicago and London: University of Chicago Press, 2010), p.31.

[8] Ibid., p.30.

[9] Ibid., p.21.

[10] The damaging effects and conceptual problems that the nature/culture conception brings has led to a series of declarations of intent to overcome or re-describe this dualism in recent theory. However, in lazier versions of this discussion, this dualism is simply denied – suggesting that there is no opposition there: nature is culture, and culture is nature. There are clearly problems with such over-simplistic formulations too. They can seem to suggest that real ecological concerns are misplaced or overstated, and that it is "natural" for humans to exploit their environment. Equally, a simple denial of the nature/culture distinction can seem to deny the autonomous reality – the real otherness – of non-human biotic, abiotic and metabiotic systems. In fact, simply denying the nature/culture opposition all together is no better than holding to an absolute distinction. I hope to have shown some ways that the dualism can be sublated or suspended in more dialectical thinking, and equally, how neocybernetic methods can help to make evident the social construction of our experience of the dualism. Both are crucial to thinking about what it is that happens in architectural and urban events at the metabolic interface or human and non-human realities.

[11] Neil Smith, 'Preface', in Nik Heynen, Maria Kaika and Eric Swyngedouw, *In the Nature of Cities - Urban Political Ecology and the Politics of Urban Metabolism* (London: Routledge, 2006) pp.xiv

[12] Friedrich Engels, 'The Part Played by Labour in the Transition from Ape to Man', in Engels, *Dialectics of Nature*, pp.182-83.

[13] Roy Bhaskar, *Dialectic: The Pulse of Freedom* (London: Routledge. 2008), p.49.

[14] Ibid., p.53.

[15] David J. Bohm, *Problems in the Basic Concepts of Physics: an inaugural lecture delivered at Birkbeck College 1963* (London: Birkbeck/J W Ruddock and Sons, 1963), p.6.

[16] David Bohm in interview with F. David Peat and John Briggs for *Omni* magazine, accessed 28.8.10 from http://www.fdavidpeat.com/interviews/bohm.htm.

[17] Ibid., p.50.

[18] Gregory Bateson, *Mind and Nature - A Necessary Unity* (Cresskill, NJ: Hampton Press, 2002 (first published 1979)), p.57.

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[19] Gregory Bateson, 'Pathologies of Epistemology' in Bateson, *Steps to an Ecology of Mind* (Chicago and London: University of Chicago Press, 2000), p.492.

[20] William Kaizen, 'Steps to an Ecology of Communication: Radical Software, Dan Graham and the Legacy of Gregory Bateson' in *Art Journal* (CCA, Fall 2008), p.87.

[21] Bateson, *Steps to an Ecology of Mind* p.354.

[22] Ibid., p.492.

[23] Lynn Margulis (widely credited with as a founder of Gaia Theory along with James Lovelock) has herself focused on research that has shown how mitochondria in all cells were actually originally independent organisms that were incorporated into cells.

[24] Bateson, *Steps to an Ecology of Mind* p.502.

[25] Ibid., p.503.

[26] Ibid., p.504.

[27] Ibid., p.505.

[28] Ibid., p.504.

[29] Ibid., p.511.

[30] Ibid., p.506.

[31] Pickering, *The Cybernetic Brain,* p.384.

[32] David Harvey, "Organizing for the Anti-Capitalist Transition" – a talk given at the World Social Forum 2010. Accessed on 5.9.2010 at www.davidharvey.org

[33] David Harvey, "Reading Capital Lesson 5", accessed on 5.9.2010 at www.davidharvey.org

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