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AN INFRASTRUCTURE OF INTERACTION
Complexity theory and the space of movement
in the urban street

A thesis presented in partial fulfillment of the requirements of the degree of
Master in Design
at Massey University, Wellington, New Zealand

Helen Reynolds
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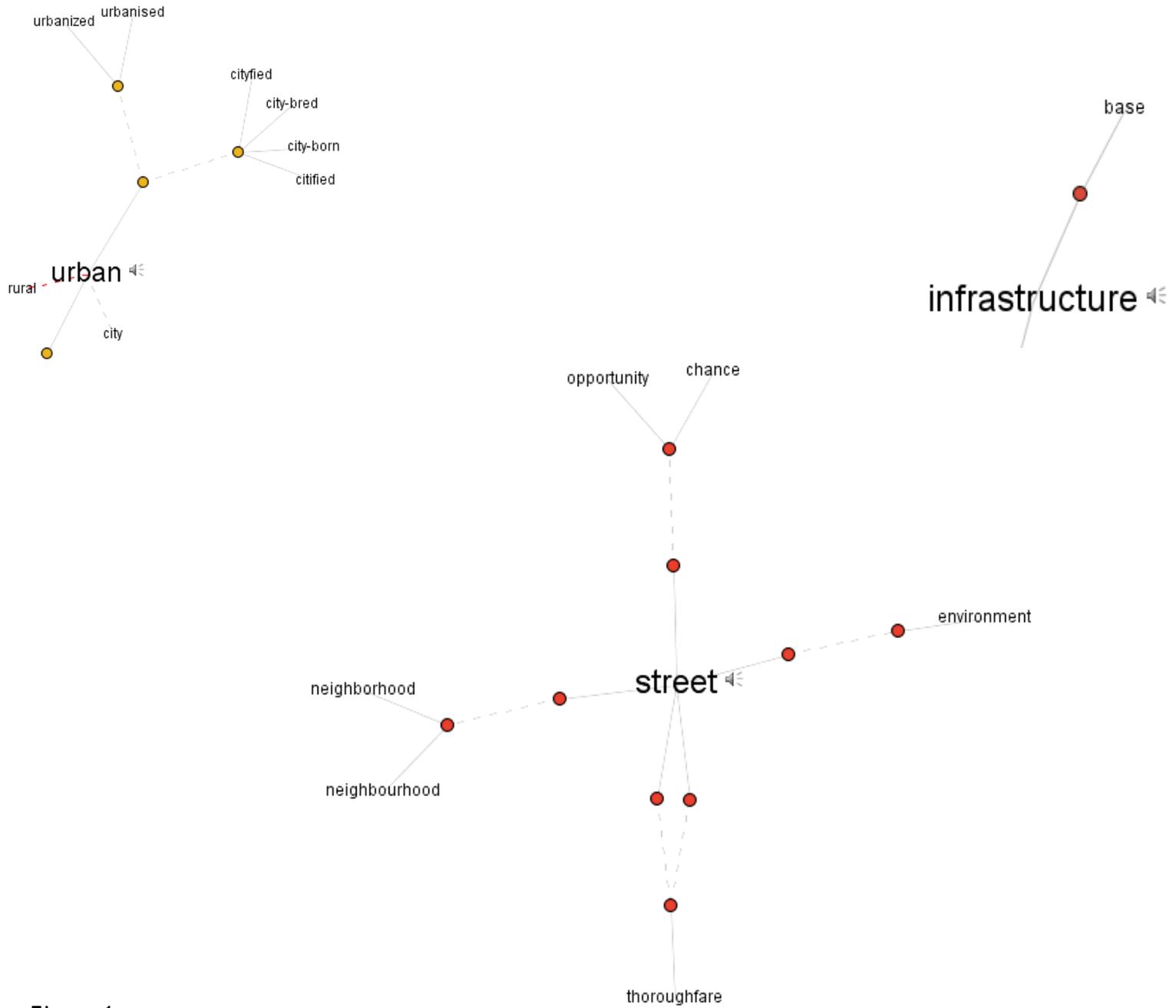
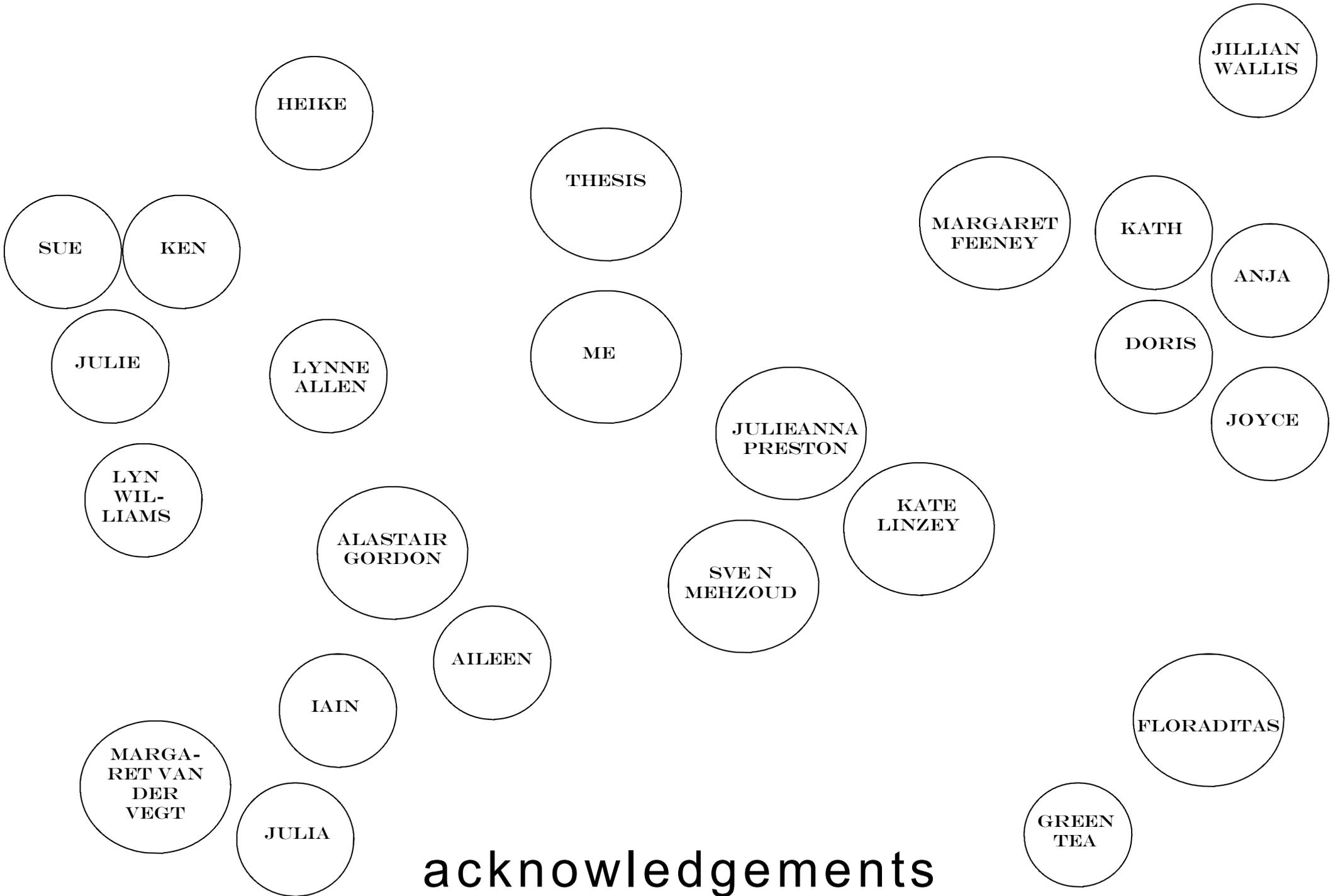


Figure 1



acknowledgements

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ABSTRACT

This study uses complexity theory to examine the space of the street. In a morpho-ecological city, process creates form just as form creates process. The process of movement is a critical form generator within the urban system.

In this thesis, the urban system comprising streets/car/pedestrian is examined. If this collection of urban modes of mobility is a complex system capable of self-organising behaviour, what effect does the ordering imposed by traffic engineering have on this system?

I look at the driving body and the walking body as co-creating the city by their movement through urban space. I suggest that, through attention to the fragments of interactions enacted during these movements, we can, through design, allow for the emergence of self-organising behaviour.

Urban shared streets, descendants of the 'woonerf', appear to function more efficiently than engineered streets, without the usual traffic ordering. The counter-intuitive success of these streets implies a self-organising behaviour that is generated by the density of interaction between the inhabitants of the street. These designs potentially work as a change agent, a catalyst, operating within a complex system. This has the potential to move

systems from one attractor state to another.

A city built with these spaces becomes a city of enfilades; an open system of spaces that are adaptable to uses that fluctuate with time and avoid thickening the palimpsest of traffic engineering.

I look at siting shared streets in Wellington, based on jaywalking, a transgressive use of the streetspace that prefigures a shared space, and changes to urban networks associated with such designs.

Interaction within the city is a creative force with a structure. City design needs to consider and address this infrastructure and design for it.

The infrastructure of interaction has been subsumed by the infrastructure of movement. Shared streets indicate there may not be a need for this – they can be integrated.

The process of movement creates instances of interaction; therefore designing spaces of/for movement must be designed to enhance the infrastructure of interaction.

The result of such interaction is not just somewhat better; it may be a phase change - catalytically better .

...all I need is a brief glimpse, an opening in the middle of an incongruous landscape, a glint of lights on the fog, the dialogue of two passersby meeting in the crowd, and I think that, setting out from there, I will put together, piece by piece, the perfect city, made of fragments mixed with the rest, of instants separated by intervals, of signals one sends out, not knowing who receives them.

Italo Calvino, *Invisible Cities*, 1974: 126



Figure 3

The complex

Complex systems are characterized by

a large number of elements

many interactions between the elements

attributes of the elements are not predetermined

interactions between elements is loosely organized

they are probabilistic in their behaviour

the system evolves over time

subsystems are purposeful and generate their own goals

the system is subject to behavioural influences

the system is largely open to the environment

(Skyttner, 2005:105–106)

Introduction

Cities are complex systems, composed of countless interactions and countless processes at work within the urban form. In this research, I investigate movement in cities as a process that is a subset of this complex system; a process that interacts with form in unpredictable and seemingly paradoxical ways. The aim of this research is to develop ways of thinking about design for walking in the urban context and ultimately to demonstrate the value of bringing insights from complexity theory into design theory and prac-

tice. A key to the methodology is Poincarre's concept of ideation arising from the clashing and connecting of two separate ideas. I first introduce the perspectives that I work from, which is to examine moving as a process and the networks of interaction that are created when people move. I then discuss how networks lead on to complexity theory and how complexity structures the realm in which I apply it, the city.

The complex system of the city is by definition unknowable; any knowledge we have of the city must always be flawed and incomplete. However, to formulate ways of operating within the city we must still attempt ways to know the city. Chapter two reviews several urban theories with particular relevance to complexity; the city of flows, De Landa's city of sedimented processes. Here I establish encounter and meetingness as a structuring device of the city. This review leads to the concept of an infrastructure of interaction that is as vital to a city as the material infrastructures.

Designers and planners since (and before) Le Corbusier have interpreted the city as a simple system, but the Radiant City is probably the most complete imagining of this simple and linear city. The Radiant City has no location; no place and no geography. This inherent placelessness of the Radiant City has worked to further reduce the complexity present in actual cities. I look at Le Corbusier's work as an example of the impact of designing a complex city as if it were simple and describe some of the problems that could arise from this treatment. In particular I ask if the problems that complexity theory would predict have occurred in actual modernist areas. Hulme in Manchester is an example of an area built according to modernist principles of the simple city and I briefly discuss Moobela's analysis of Hulme which is based on the argument that social systems broke down after the street was 'replaced' by walkways in the sky (Moobela, 2005).

Modernist city design is linked with encouraging car movement. In order to develop a critique of the car-centric city, I look at the history of the road from the early twentieth century. The evolution of the road is, of course, not independent or isolated from the history of the motor vehicle and this study continues by examin-

ing the development of the car body and the nature of the feedbacks involved in this development. This involves placing the road and the car into the context of the economic and military systems of the time, and the ways in which the car and the road interact with these systems.

In this context, the debate on whether the car-centric city is 'good' or 'bad' is relevant. I examine this issue and its relationship to how we should consider designing in a complex system.

The argument is made that processes create form and form creates processes. As a result, design must be as much about process as it is about form. I therefore examine the processes of walking and driving and the nature of the interactions they create. Understanding how these interactions are created is an important aspect in city creation and design.

This research into complexity theory, movement processes and urban design led me to first the woonerf, a residential street typology without a speed-based hierarchy, and then the shared street, an urban street based on similar principles. The alteration of movement process affected by shared street design seems to have produced results that could not be accounted for by a reductionist analysis of traffic and movement, but can be explained by application of complexity theory.

I base an initial design on observation of the interaction between walkers and drivers: jaywalking.

As a result of the review and research outlined above, it becomes clear that if we approach actual physical design with such a strong process orientation then issues may arise; notably a realisation that this does not give a strong focus to the many formal decisions that are required in a design. This expands the question of designing with complexity and raises new questions. Can the theories of complexity be used to gain insights into the formal aspects of design? What is the nature of interactions between form and process that are contained in a design? To approach this finally in this thesis I look to writings by Baudrillard, Fritjof Capra, Robin Evans and de Certeau. It is argued that this expanded question of how formal design

is connected to process design offers important clues to improving urban design theory and indicates ways in which complexity theory may in future be able to inform this important consideration in design.

Chapters are prefaced by 'laws' from general systems theory, laws which work at parallel to the text.

I
The complementary law
or,
Aims and methodology

The complementary law

The complementary law (Weinberg, 1975) suggests that any two different perspectives (or models) about a system will reveal truths regarding that system that are neither entirely independent nor entirely compatible. More recently, this has been stated as: a complex system is a system that has two or more non-overlapping descriptions (Cohen, 2002). I would go as far as to include “potentially contradictory suggesting that for complex systems (by which I really mean any part of reality I care to examine) there exists an infinitude of equally valid, non-overlapping, potentially contradictory descriptions. ... The complementary law also underpins calls in some complexity literature for philosophical / epistemological / methodological / theoretical pluralism in complexity thinking.

(Richardson, 2004a:76)

The process of aiming

The search for boundaries encourages a treatment of territory as a container, widening the dimensioning of the container to capture the most significant relationships rather than working with concepts of discontinuous space and the multiple spatial 'reach' of different networks transecting a territory...Such 'container' and 'positioning' treatments contrast with the focus on fluidity, openness, and multiple time-space relations emphasized by relational complexity ideas. (Healey, 2005:150)

Despite the conflict between relational complexity and boundaries expressed above, a master's thesis must have boundaries (boundaries of time, scope, word count) where the text functions as a container for the work.

Process is a critical to this study, and rather than the linear (and in this case, at least, imaginary) arrow of



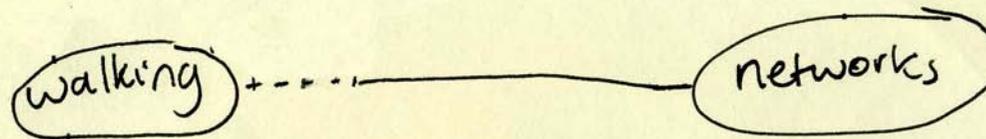
Figure 4

I present my aims as a process.
Twists, turns and dead-ends were part of a study that conceptually necessarily demands a "discontinuous and multiple wander through a territory" (Healey, 2005:150).
This process started with the aim of looking at these two things:



Figure 5

and see what ideas about the city and it's spatial design could be developed from their combination.



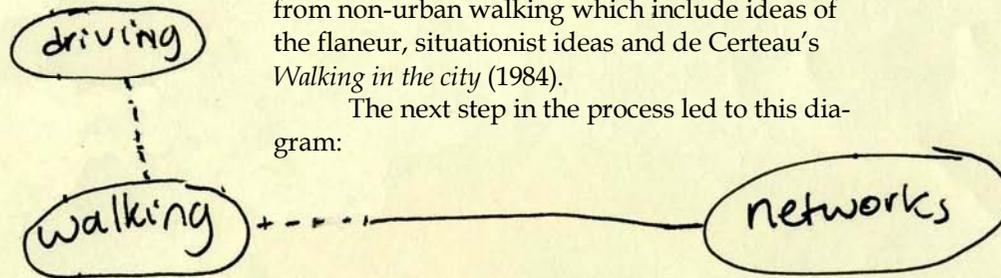
I was specifically interested in the process of

Figure 6

Figure 7

walking in the city; it seems to have a different nature from walking in less densely inhabited spaces such as walking in the suburbs, through the bush or along the beach. Urban walking has developed schools of thought distinct from non-urban walking which include ideas of the flaneur, situationist ideas and de Certeau's *Walking in the city* (1984).

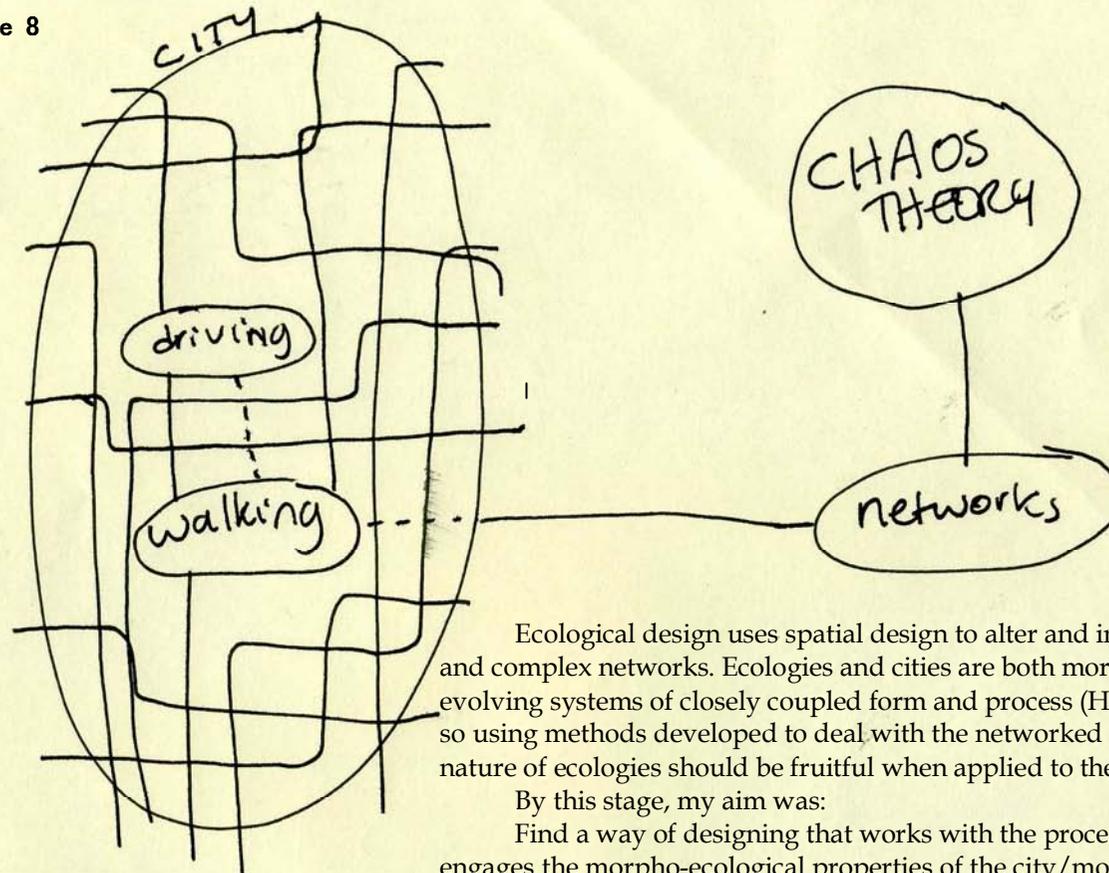
The next step in the process led to this diagram:



Driving kept coming up – how was it different from walking? Why was I privileging walking? What was the relationship between driving and walking? Networks led directly to chaos theory and complexity, to self-organising adaptive systems and emergence. A relationship between walking and emergent properties of cities has been suggested by Steven Johnson (Johnson, 2001:91). Swarming as self-organising behaviour and emergent paths created by the iterated movements of walkers form other connections between complexity theory and walking.

The aim of this research evolved into 'investigating and developing design tools for walking in the urban landscape that work with complexity theory.'

Figure 8



Ecological design uses spatial design to alter and intensify intricate and complex networks. Ecologies and cities are both morpho-ecologies, evolving systems of closely coupled form and process (Hensel et al., 2004:9) so using methods developed to deal with the networked and self-organizing nature of ecologies should be fruitful when applied to the city.

By this stage, my aim was:

Find a way of designing that works with the process of walking and engages the morpho-ecological properties of the city/movement system. The intent of any such way of designing would be to act as a catalyst on the

system, tipping the city towards an attractor state of 'walkable city'. Focusing on the *process* of walking would equate to a 'bottom-up' method of designing, in contrast to the more usual 'top-down' methods of urban design.

This aim at this stage was still too unfocused.

Using ecological design as a precedent, I was modelling the walking person as a prey species and the car as a predator species. It struck me that there was a major flaw with this model - a predator species *needs* to eat the prey species to survive but drivers hardly *need* to kill pedestrians. Driver or walker, we are the same species.

This observation helped to focus my research on the woonerf, a Dutch residential street designed such that all users of the space have equal rights to the entire surface whether playing, walking or driving. This notion treats the walker, not as something that needs to be protected from a dangerous predator, but as members of the same species as the driver.

As well, the amount and complexity of play on woonerfs increases (Ben-Joseph, 1995:510). Play is a honey-pot to those looking for emergent behaviour - when play suddenly breaks out, *something* has catalyzed emergent behaviour (Vogiazou et al., 2005).

For a brief but happy moment I thought the idea of transposing the woonerf into the urban situation was a new and original proposition, but further research revealed that the concept of the woonerf is already being incorporated in urban 'shared streets' were already built. Removing, in varying degrees, the top-down ordering of traffic, was arguably working

both *with* self-organising behaviour (swarming and an apparent phase change in driver behaviour) and *creating* self-organising behaviour. Traffic accidents were reduced and traffic seemed to flow through faster (Leeuwarden, 2007:6-7). I hypothesised that, in the words of Stuart Kauffman, we have 'order for free' breaking out (Kauffman, 1995:71).

My aim, while being too broad, had arguably led to a specific answer.

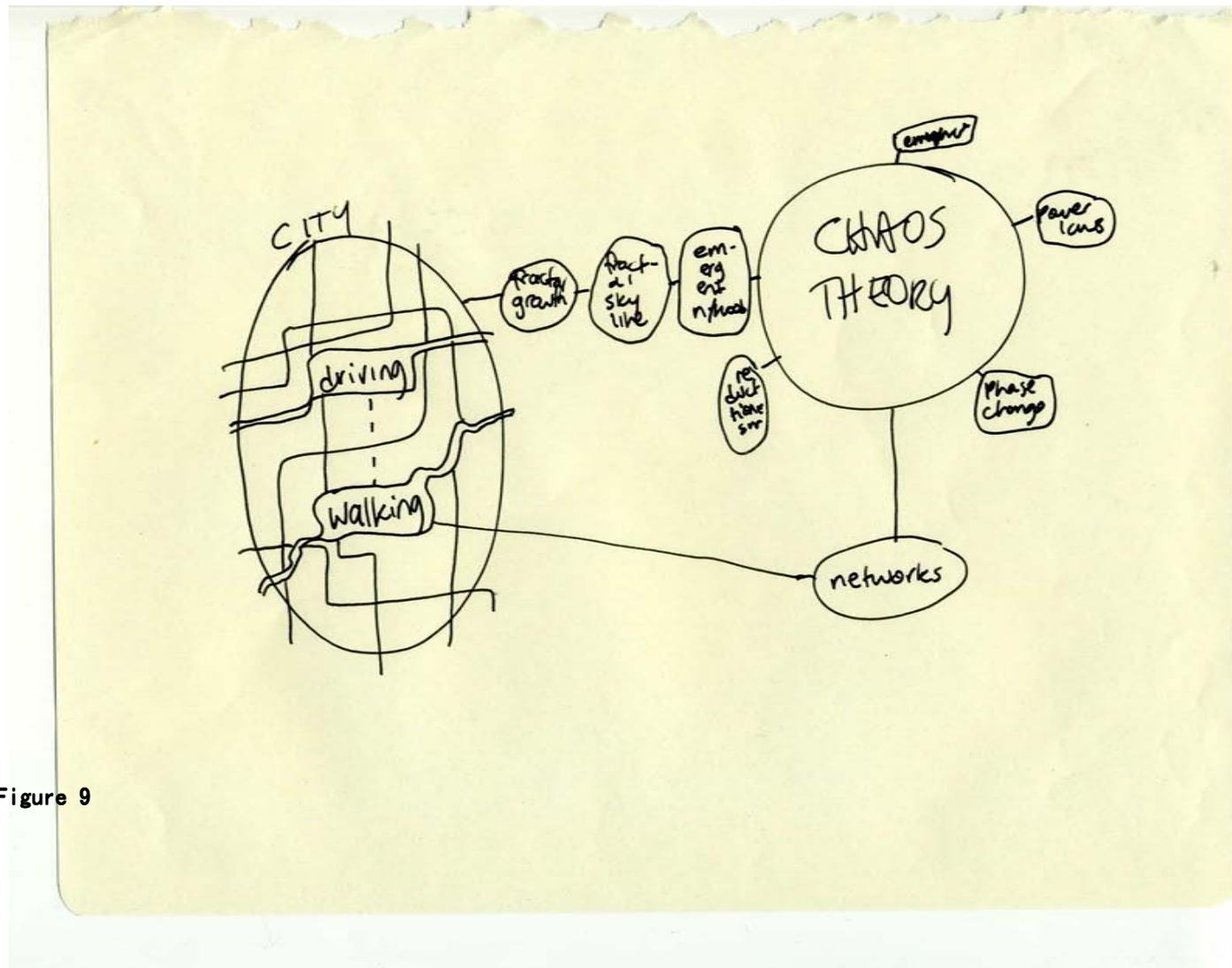


Figure 9

Towards a methodology for complexity

...creativity is the articulation of transformed parts out of novel wholes, where the novelty in the parts owes to the constraint of the whole that configures them, and the novelty of the whole is the originality and degree of empowerment given to the parts to emerge. (Brown, 1997:39)

In order to achieve these aims, I needed to advance (at least my own) knowledge on how complexity theory might affect both the processes of the designer and how complexity effects the built form of the city.

Among the works on design and complexity, there is no single, handy manual on complexity for designers. Hensel, Menges and Achim's work *Emergence; morphogenetic design strategies* stands out as an intriguing and rigorous work. Much of their design methodology uses agent-based modelling tools, tools I would struggle to learn to use in the time. As a result, a lot of my research centred

around creating a bricolage of ideas on complexity from a wide range of disciplines and considered how they would apply to design.

Considerable work had been done on the ways in which complexity effects work within and on cities. In particular Michael Batty and his research team have extensively modelled city processes, and Manuel De Landa in the first section of *1,000 years of non-linear history* interprets the cultural history of cities as self-organising morpho-ecologies (Batty, 2005, De Landa, 1997, Batty et al., 2006). These researchers did not attempt to examine how individual acts of design might affect the complex systems of cities, so I have had to draw inferences and conclusions from these and other works.

In order to find an intersection of urban design and complexity theory, I spent some time researching urban design history, looking for designs that appeared to have

effects on the city that could be accounted for by complexity theory. As my focus was on the processes and interactions of movement, it was necessary to also research the history of traffic design and engineering as much as the formal aspects of urban design. This research became particularly interesting as the research focused on the shared street and its potential to form an effective critique of traffic engineering.

Complexity is concerned with the iterative interactions of agents acting locally. The sensory interactions of the body with the environment are multiply iterated interactions, meaning phenomenology can contribute to understanding complex systems comprised of people.

The hierarchy of complex systems is convoluted rather than nested (Richardson, 2004b:79). I think this means that one scale of the system is not more important than another. Knowing the individual, personal, experiences of the city when iterated are as impor-

important to an understanding of the city as knowing the large scale city-wide or patterns or, just as importantly, the scale of the street.

Finally, the question of how to apply these findings to a particular city needed to be broached, if not fully answered. Further questions arose: On what basis does one site shared streets? What effects emphasising self-organising as a generator of urban order might have on networks connected to the changed spaces? In some instances I have suggested answers; other questions remained unanswered.

This article is not so much the written exposition of an argument as the development of some ideas by writing them down. Much of the sense of it only emerged in the drafting and redrafting. (Evans, 1997a:196)

...even random assembly of simple logical elements leads to surprisingly sophisticated logical operators through a process of evolutionary self-organisation. (Schuster, 2006:10)

It has been put that innovation is emergent behaviour. (Carlisle & McMillan, 2006:2). Individual ideas are part of networks of ideas. Combining two closely clustered ideas creates new ideas, but perhaps not ones that stray far from their home-ground in a fitness landscape. Combine two ideas that are more widely separated, more distant in the network of theories/knowledge and the resultant hybrid is more likely to explore new areas of the fitness landscape that makes up all possible theory/knowledge.

Take two concepts; let's call them agents in the network of ideas. Create a structure of interaction between them. Allow the concepts to communicate with

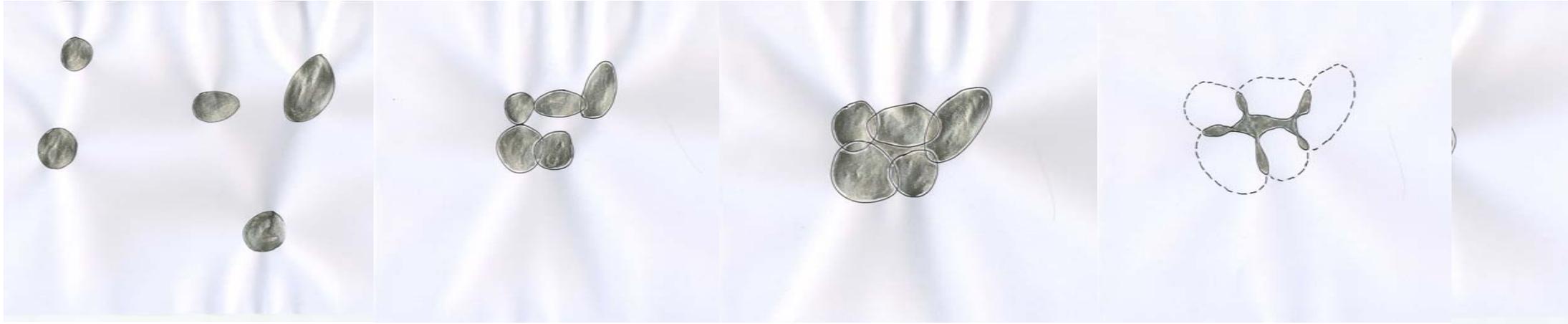
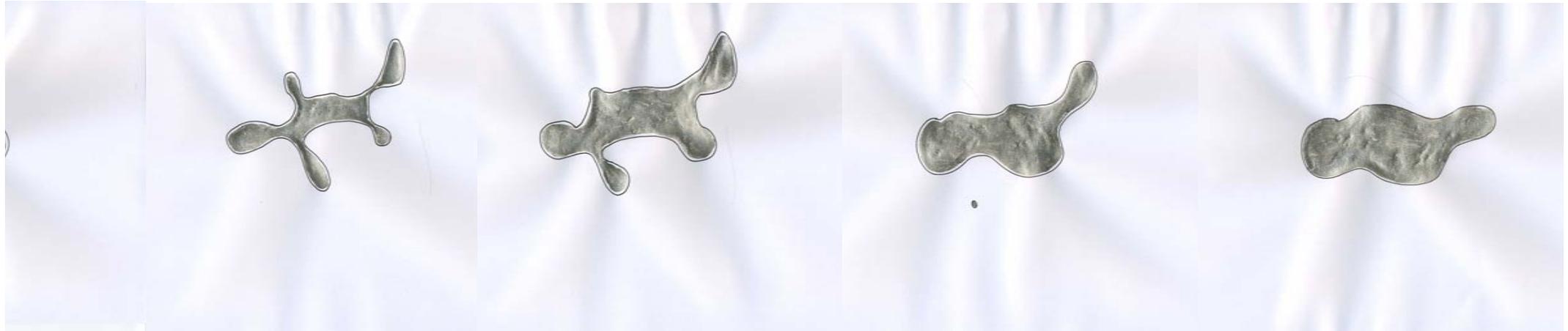


Figure 10 Idea nodes undergoing iterations of connection to become a new idea:



The great mathematician Henri Poincaré wrote in 1908: “One evening, against my custom, I drank a cup of black coffee and could not sleep. Innumerable ideas came to my mind and I felt them knocking against each other until two of them stuck together, so to speak, and formed a stable combination.” (Henri Poincaré, cited in Bowen, 1999:2)

each other. How does concept A affect concept B? Create a path through the graph of the network of ideas connecting A to B. Iterate the interactions, examining them through a number of other connected concepts. Find further, related connections to the original concepts. Undertaking the work of drafting creates a new network of connections. There are constraints to the structure of writing (a degree of linearity, for example, a grammar...) but emergent processes require some kind of structure.

Connections are thickened through literary devices like repetition and metaphor. Metaphor is a way of discovering structural similarities between two concepts, ideas or processes; "this process of metaphorical projection is a crucial element in the formation of abstract thought ..." (Capra, 2002) 63. Keep

iterating these connections through rewriting and editing, finding the most relevant connections to the project and tightening these connections to create something that is not exactly a boundary, but a focus, for "[s]ocial boundaries...are not necessarily physical boundaries but boundaries of meaning and expectations. They do not literally surround the network, but exist in a mental realm that does not have the topological properties of physical space" (Capra, 2002:88).

Complex systems are not completely knowable (Skyttner, 2005), but leave traces. The *trace* of a complex system is graspable, and assessable with the same system we use to assess the drawn trace – aesthetics (McKenzie & James, 2006). An aesthetic judgement must be made, has the work become an aesthetic whole? When have the interactions been iterated enough to create a new pattern (McKenzie & James, 2006). Edit. What can be taken away

and leave the work still as whole? Taking something away means the thing falls apart as a whole – we have been too reductionist. Put that something back. The process of editing creates more complexity effects. Restructuring is a top-down organisation that sub-optimises, or creates disarray, within the modules of the chapters. Editing from the bottom up, line by line, in turn sub-optimises the larger network of the thesis structure. I will never be able to achieve total control of the written work, saving me from the disaster of central control (Schuster, 2004).

Choosing the feedback loop gives a particular direction to the evolution of the emergent concept. Placing this within an academic framework means feedback is from supervisors and eventually examiners. The work of innovation takes on a particular form as a result of this, quite different from the way it would evolve in response to feedback from clients and the markets.

The process of design is also a way of combining different ideas, but the structure of the design process is very different from the structure of the writing process, therefore the knowledge that emerges from research through design is different from the knowledge that emerges from writing.

The emergent nature of innovation is why the same idea can be 'newly' thought of in different places and times. The innovators have received/has access to the same cluster of existing

ideas and their interaction has had the same emergent behaviour. Kauffman call this "the inevitability of historical accident" (Kauffman, 1995:186).

Theories are evolutionary - the accretions of the systems of thought - in the same way that flora and fauna are the accretions of the biological evolutionary process.

Methodology

This research attempts to show how a scientific theory (complexity) can offer insights for urban and landscape design and in doing this I utilise methods drawn from both design and science perspectives. If it were ever claimed that there is a standard methodology for complexity research, the complementary principle ensures that the employment of a different strategy, and the resulting different conclusions will continue to add to the knowledge of the system studied, rendering this hypothetical 'standard' methodol-

ogy incomplete.

Groat and Wang say there are divergent end points to research, depending on whether one takes a scientific route or a mythical, poetic route. Scientific explanation is "made up of linked fragments; it is thereby atomistic, reductionist, and convergent...On the other hand, mythic or poetic description is seen as continuous, holistic, divergent, and generative..." (Groat and Wang, 2002: 25). This research cannot claim a scientific methodology; nevertheless a large number of my sources have been scientists. An atomistic style has infected my writing, yet complexity theory resists the reductionist and convergent, and instead explores the holistic, the divergent and the generative. Indeed I do not expect this research can be placed neatly on the sort of continuum Groat and Wang picture, but rather, it operates from multiple places on a scientific/poetic spectrum.

The linking of fragments taken from a variety of disciplines, including biology,

ecological design, urban and cultural theory, physics, philosophy, architecture and landscape architecture is the basis of this research. The aim of this linking is to find new connections, new ways in which understandings from one discipline (as well as fragments from my own experience) can inform each other.

These fragments are connected within the framework of complexity theory with the aim of generating deeper understanding of the ways in which landscape architecture can operate in this complex environment.

Using complexity theory as a framework of connection is a methodology of logical argumentation, one which “tend[s] to take a set of previously disparate factors...and interconnect them into unified frameworks that have significant and sometimes novel explanatory powers” (Groat & Wang, 2002: 309). My primary aim is to connect the ideas

of urban walking and network (and then complexity) theory together.

This small connection expanded significantly as I discovered there was no single authoritative voice on complexity theory in design. A number of people, Paola Gregory and Stanford Kwinter for example, had done interesting work in the nineteen nineties but, as a new and quickly expanding field of research, complexity theory itself had developed immensely since that time. More recent works on complexity and design tended to be specialised and not particularly relevant to the systems I was working in. A somewhat broader scale ap-

approach was therefore needed. In the chapter on complexity and design, source material from complexity is applied to the system of design. Induction is then used to find indicative guidelines on designing in complex systems. From there, I focus on working towards a more specific case. This was achieved by a broad survey of urban and street design, looking for indicators of emergent behaviour and other signals of complex systems.

While quantitative tools were not used as

part of this research, I have drawn on international quantitative research on the shared street.

Tactics of naming, story and graphic images are ways of elaborating or confirming the construction of a system of logical argument (Groat & Wang, 2002: 323). The chapter on the city of flows names the city as a complex system, here justifying the use of complexity theory to analyse it.

Story is traditionally linear but the way I have used story in this thesis is not strongly linear. This is congruent with the idea of the city as non-linear, both spatially and structurally. The use of story in this thesis is informed by the carrier bag structure of story, as posited by author Ursula Le Guin. Le Guin compares this linear narrative structure to the hunter's actions of taking a pointed stick, aiming the stick at prey and concluding with the death of the prey. With this metaphor, she portrays the linear narra-

narrative structure of story as a masculine tool. A model she prefers is the 'carrier bag' structure of story (Le Guin, 1989, 168). A prehistoric gatherer's tool is a carrier bag, a tool that holds what she has found:

I would go so far as to say that the natural, proper, fitting shape of the novel might be that of a sack, a bag. A book holds words. Words hold things. They might bear meanings. A novel is a medicine bundle, holding things in a particular, powerful relation to one another and to us. (Le Guin, 1989:169)

The story in this thesis is not particularly linear, but the city is not linear, either spatially or in terms of complexity. The journeys made, and the connections that result, are multiple, not linear. An appropriate narrative structure for dealing with the topics of city and complexity would seem, therefore, to be more like a 'carrier bag' than a spear. In this writing, I seek to find the multiple connections possible in the material.

Diagrams of a variety of complex systems are included as a tactic of graphic image. The reason for this similarity of the structure of seemingly very different

systems is strikingly similar, lending strength to the argument that results form ecological design are applicable to the urban system.

As well as diagrams, photographs by Alastair Gordon illustrate moments of small interactions between people in some of the world's most densely occupied streets. He takes photographs at one minute intervals and I drew on his library of urban moments when interactions correspond with the text (Reynolds and Wallis, 2006).

Induction is the main tactic used in the chapters on The Radiant City and the history of the road. If the Radiant City is examined as a system, what sort of system does it represent? What are the effects of operating on a mis-categorised system with inappropriate tools? Deduction is used in these two chapters to answer these questions. The history of the road incorporates re-framing, based on the question 'what if the current road system is not the only valid system'. This allowed for a new examination of historical sources.

The chapter on complexity in design is largely a furthering, through inductive reasoning, of Kauffman's hypothesis of technological objects as organisms evolving in a cultural system. Kauffman draws a parallel between the evolution of organisms in the complex biological system and the evolution (Kauffman, 1995: 179). If this is so, and the parallel holds for 'designed objects' as much as 'technical objects' then what is the role of the designer within this system?

2
The darkness principle
or,
The city of flows

The darkness principle

The darkness principle says that “no system can be known completely” (Skyttner, 2001: 93). The concept of incompressibility suggests that the best representation of a complex system is the system itself and that any representation other than the system itself will necessarily misrepresent certain aspects of the original system. This is a direct consequence of the nonlinearity inherent in complex systems. Except in very rare circumstances nonlinearity is irreducible (although localized linearization techniques, i.e., assuming linearity locally, do prove useful). There is another source of ‘darkness’ in complexity theory as reported by Cilliers (1998: 4-5): *“Each element in the system is ignorant of the behavior of the system as a whole, it responds only to information that is available to it locally. This point is vitally important. If each element ‘knew’ what was happening to the system as a whole, all of the complexity would have to be present in that element.”* (original emphasis). So, there is no way a member of a complex system can ever know it completely - we will always be in the shadow of the whole.

(Richardson, 2004a:77)

The city of flows

Infrastructure accompanies places of habitation, systems to organise the flows that are part of human life. Flows of water, power, sewerage, waste, food, money, news, stories, sex, friendship, kinship, trends, TVs, iPods, blankets, cars, trains, buses and people themselves. Infrastructure acts as conduits for these flows. Rural and suburban areas have infrastructures, but it is in the cities that infrastructure intensifies, becomes knotted and entwined. The city is viewed as a thickening of infrastructure in a particular place, with a multiplicity of infrastructures carrying flows. If place “is constructed out of a particular constellation of relations articulated together at a particular locus” (D. Massey, cited in Larsen et al., 2006:14), then the place of the city is created by these flows and their infrastructure.

This city, where flows and built form are linked in a complex system, shows itself as a morpho-ecological entity, with potential for self-organising and/or emergent behaviour.

The traces made by these movements, these flows, this “threadwork of intensities” (Amin & Thrift, 2002:81) create the drawing of the city (also envisaged as writing the city). This drawing, this track making, “allows[s] the city to be known. We negotiate the city

through used tracks and construct imaginaries around them of the known city. This is one way in which a city, with all its complexity, size and change is named" (Amin & Thrift, 2002:22).

These flows are all embedded in space by their infrastructures. The depth of their embedding varies, from lightly in the case of networks created by the mobile phone, to the deep buried water pipes and the huge geographical infrastructures of rivers, harbours and seas.

While the more lightly embedded infra-

structures have stretched the spaces of the city, simultaneously separating geographically adjacent and connecting geographically distant (Amin & Thrift, 2002:22), landscape architecture has a tradition of working with the deeply embedded infrastructures, and a current interest in connecting the infrastructure, city and ecology in landscape urbanism.

Landscape urbanism claims process in time as central concepts of landscape architecture and the city (Corner, 2006), with infrastructure as the ordering mechanisms of the urban field (Waldheim, 2006:39). Stan Allan states, "[i]nfrastructure works not so much to propose specific buildings on given sites, but to construct the site itself" (Allan, 1999:54).

This leads to an understanding of the city not as a collection of buildings, but rather as a collection of flows. As Nigel Coates says, "...here a lighter, less territorial urban condition has formed; one that reads the environment in terms of energy and process as well as physical space...Here, the medium of architecture has transformed from one of

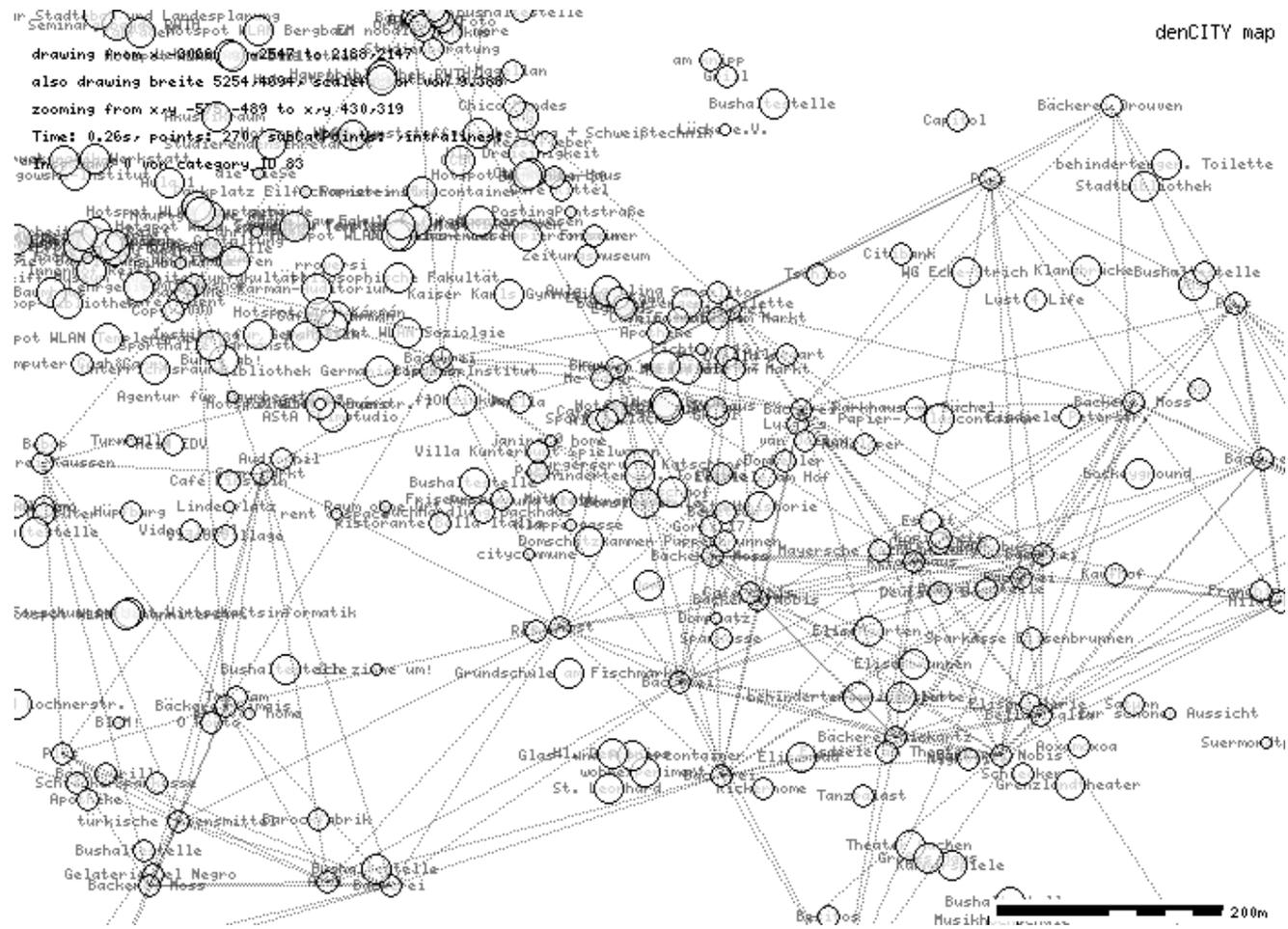


Figure 11 denCity.net project uses mobile phone tagging.. This is Aachen, Germany. Administered by Kai Kasagi and Philipp Hoppe

bricks and mortar to one of shifts and flows" (Coates, 2003:93).

This knotting, this concentration of infrastructures, this complexity, means that interactions *between* the infrastructures arise. Therefore urbanism cannot be just about the form of the infrastructures, or about the orderings of the infrastructure/flow networks but "everyday urbanism has to get into the intermesh between flesh and stone, humans and non-humans, fixtures and flows, emotions and practices" (Amin & Thrift, 2002:9).

De Landa examines this intermesh in *1,000 years of non-linear history*. He describes the built form of cities as accretions of the complex systems of humans concentrated spatially.

...human populations began mineralizing again when they developed an urban exoskeleton: bricks of sun-dried clay became the building materials for their homes, which in turn surrounded and were surrounded by stone monuments and defensive walls. This exoskeleton served a purpose similar to its internal counterpart: to control the movement of human flesh in and out of a town's walls.

(De Landa, 1997:27-28)

The built exoskeleton in turn regulates the flows and processes of interaction within and between cities and, in this way, continues to influence the mineralization of the cities. De Landa shows the city to be a morpho-ecological entity, created by the interaction between its physical formation (mineralization) and simultaneous flows of information. The evolving physical city modifies the nature and type of information flow, and information feedback itself influences the creation of the city.

Virilio describes the ways in which flow construct the city:

This technological deregulation of various milieux is also topological to the extent...it inversely and paradoxically builds an imperceptible order, which is invisible but just as practical as masonry or the public highways system. In all likelihood, the essence of what we insist on calling urbanism is composed/decomposed by these transfer, transit and transmission systems, these transport and transmigration networks whose immaterial configuration reiterates the cadastral organization and the building of monuments. (Virilio, 2003:286)

Jane Jacobs saw cities as sites of complexity in *Death and life in the great American cities* (1961:436).

Michael Batty has studied cities and complexity using agent-based modelling in considerable depth. With his collaborators, he has built models of city growth that show the fractal nature of this phenomenon and the striking similarity to growth patterns of actual cities over time (Batty, 2005).

The agent-based cities show the morphology of sprawl, edge cities and segregation apparent in real cities (Batty et al., 2006). He defines the city "as the connected pattern of settlement that fills an entire space where everyone can connect to everybody else either directly or indirectly" (Batty et al., 2006:65). (This is a definition perhaps unintentionally highlighting globalisation, as this could work as a definition of the world.)

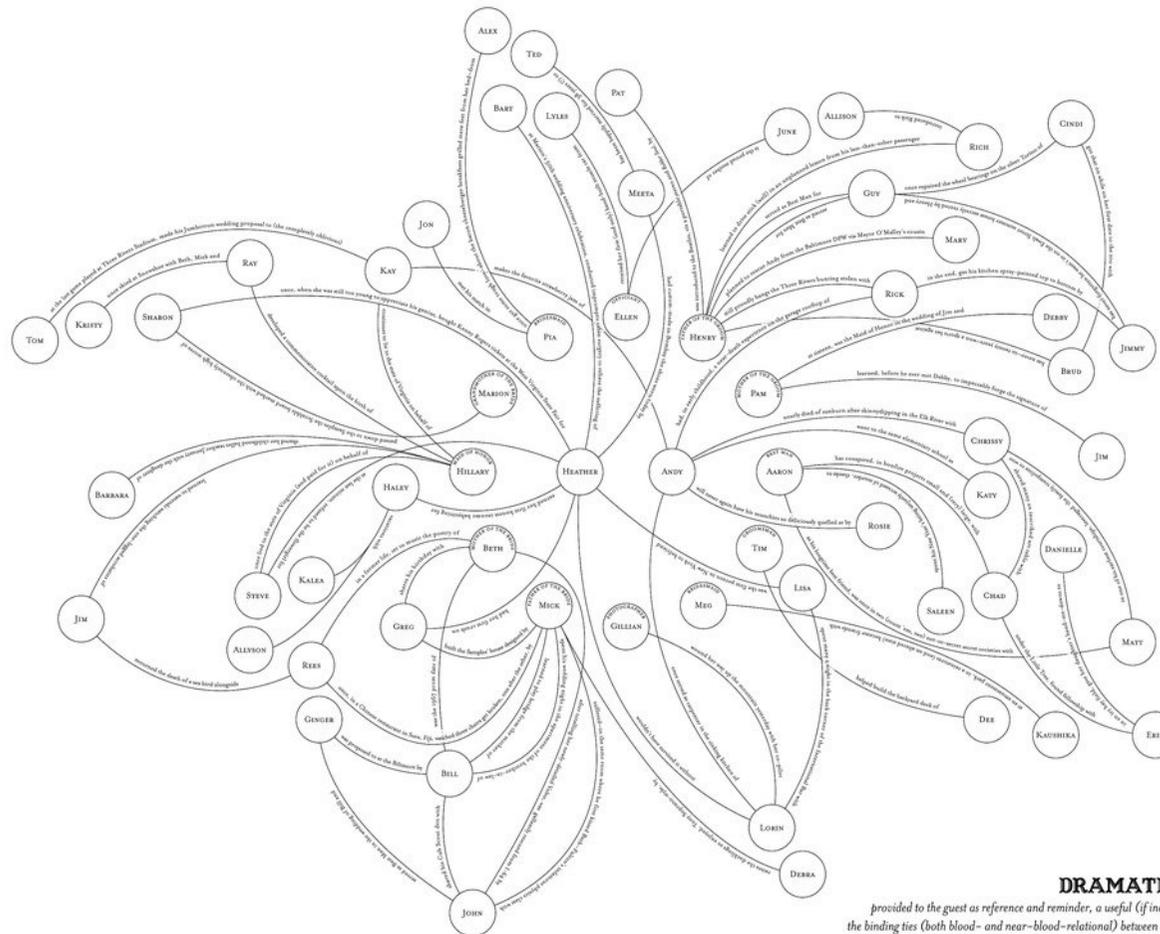


Figure 12 Social network of guests attending the wedding of Andrew Coulter Enright and Heather Samples in 2007, by Enright and Samples

The interactions that create cities are multiple. Paul Krugman models the economic connections in cities, the connections made through manufacturing goods and selling them (Krugman, 1996). The local economic interactions he bases his models on create edge cities, centralised CBDs and multi-centred cities. The segregation model by Schelling, based on agents moving the place of their 'residence' to be closer to other agents 'like' themselves, creates patchworks of neighbourhood patterns that echo the class and ethnic clustering of real space (Krugman, 1996:15).

These models confirm the idea that the huge variety of connections that exist in

cities come together to co-create the forms of the cities that we know and live in; that it is the connections and interactions that are as important to the shape of the city as design is.

Encounter - meetingness

The flow of information through the city network is not a simply mechanical flow, a flow for the sake of flowing, but rather a flow with the purpose of eventual interchange and utilisation of information. This interchange is enacted by encounter, meaning the number of links a social network contains is important, but the number of meetings is just as important (Larsen et al., 2006:19). The network must be "... 'activated' through occasioned co-presence" (Larsen et al., 2006:19).

Because flows require time and because interchange and the

end utilisation all require time to happen, time passed is an essential component to the development of emergent behaviour in this city. Furthermore, history of the system is embedded in the structures mineralised in the city, and this mineralization continues to order the city.

Given the geographically disconnected yet virtually connected nature of the present, how important is meeting physically? Bertolini questions how important person-to-person contact is in the contemporary city, pointing out all the vir-

tual processes that continually de-couple space and communication. Within this, he sees that people still want to meet each other, and this de-coupling of space and communication has been accompanied by an increase in business travel (in order to meet in space) and an increase in social opportunities to meet, like festivals (Bertolini, 2005).

This relationship is not linear, but follows the co-creating aspects of complexity. "Urbanity is a phenomenon which causes, and at the same time is caused by, direct dialogue between people" (Bobic, 2004:41). This condition of encountering can be seen as the attribute of urbanity itself, something that distinguishes the urbane from the suburban. "[E]ncounter, and the reaction to it, is a formative element in the urban world. So places are best thought of not so much as enduring sites but as moments of encounter...." (Amin & Thrift, 2002:30).

Encounter between the inhabitants of the city is therefore an important ordering

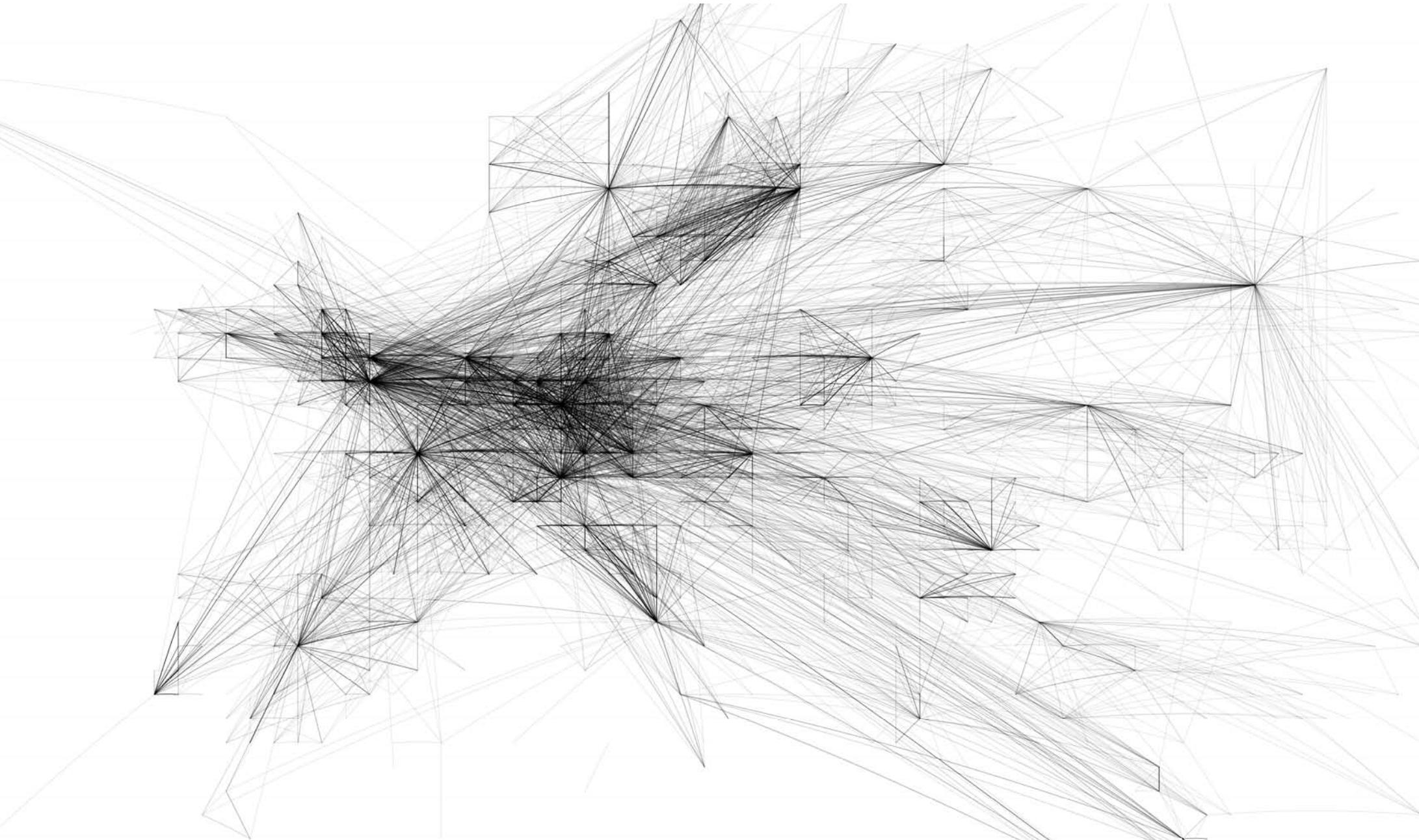


Figure 13 European internet city to city connections, by Chris Harrison

device of the city. This infrastructure is the underlying framework of a system, and 'encounter' also has a related framework or structure. Writing in the 1930s, Louis Wirth describes the changes in structure that accompany urbanisation:

While in the one hand the traditional ties of human association are weakened, urban existence involves a much greater degree of interdependence between man and man and a more complicated, fragile, and volatile form of mutual interrelations over many phases of which the individual can exert scarcely any control. (Wirth, 1993:103)

Cities put a great deal of energy and money into creating and maintaining their infrastructure of water, power, vehicle movement, waste collection, but not to an infrastructure of encounter. Designing the infrastructure of encounter, the infrastructure of interaction is an important and under-examined work of urban design. This infrastructure of encounter and interaction is a vital infrastructural device of the city.

3
The sub-optimisation principle
or,
The Radiant City

The sub-optimization principle

If each subsystem, regarded separately, is made to operate with maximum efficiency, the system as a whole will not operate with utmost efficiency." (Skyttner, 2005:100)

We can also add the reverse: if the whole is made to operate with maximum efficiency, the comprising subsystems will not operate with utmost efficiency. (Richardson, 2005:104)

This is a chapter that tells a story of damage that has been done. Using the mask of reductionism, a mask that can block out most of the complex, dynamic world and see only the linear relationships and the simple systems, people devoted to doing good work and making better places starved the city of interaction and connections.

The city, a thickening of infrastructure, a phase change brought about by the complexity of the dispersed web of interactions, is modularised and segregated in an effort to release it from 'chaos'.

I look at Le Corbusier's Radiant City as a particular example of a device that works as an anti-emergence machine. His conviction and passion shine through the pages of *The Radiant City* (1933).

Modernist design and traffic design make a common faulty assumption. They

assume streets have a modular role in the city, that the street is the infrastructure of movement, and movement only. This reduction of the street to a road converts it from a place of multiple uses to a place of unitary use, a module in a city made brittle and hierarchical.

Reducing

"Modernism becomes a project that demands our total commitment against the forces of irrationality and chaos" (Cilliers, 2006:106).

The messy and hard to predict world can be taken apart again and again until the discrete units are

simple to understand and their behaviour is predictable (Cohen and Stewart, 1994, Casti, 1994). The results are dazzling. By reducing the complexity of the world down to simple elements, science found simple, powerful truths. Even complexicists can call reductionism "humanity's greatest construction." (Cohen and Stewart, 1994:178).

The power of this approach lured those concerned with human systems. Marxist theory, for example,

...seemed like a means of extending the reliability of science over the whole area of practical thinking – a way of spreading it that would be free from doubtful value-judgements, since the theory was impartial, non-sectarian, essentially scientific. The modesty of science was to be combined with the constructive achievement of a new and central moral insight (Midgley, 1992:141)

Designers believed they too, could break down the complex, messy world they were designing for down into simple, powerful truths and design for those truths. Form, too, was reduced to follow the simple, powerful forces of function.

Perhaps modernist design principles work brilliantly when applied to simple systems. But designing for these separated parts means ignoring the subtle interactions that

create order or emergent behaviour. Systems made of living beings are never totally susceptible to a successful reductionist approach (Cohen and Stewart, 1994:182) , meaning people and society cannot be 'reduced' to find out what makes lives happy or sad and societies good or bad.

A devotion to reductionism is hardly wrong, especially before chaos theory was developed, but one can be 'blinded' by rationality and subsequently ignore the counter-intuitive effects of complex systems – or not only ignore them, but sneer at those who point them out.

This new knowledge means that rationalisms of the past are no longer rational: “rational comprehensive planning is actually an irrational assumption...”(Moobela, 2005:34).

Modularity and sub-optimization

In *The radiant city* Le Corbusier reduces living to these modules:

TO LIVE
TO WORK
TO CULTIVATE BODY
AND SPIRIT
TO TRAVEL ABOUT
(in this order and
obeying this hier-
archy)

(Le Corbusier, 1933:title page)

Each of these modules is then individually and rationally designed for. His next step is to assign the modules to separate areas on the plan. Connection is pro-

provided for by the car, for “the civilization of the automobile replac [es] that of the railroad” (Le Corbusier, 1933:7).

Within the radiant city, residences are entirely in one part of the city, factories in another part of the city, civic work is in its own separate zone, heavy industry in another. Each part is rationally designed to provide for what Le Corbusier believes comprise all (for example) residential needs. Walking is assumed to require sunshine, grass and trees. The irrational, the unknown and the random encounters of the complex city are edited out. The chance encounters, the elements of exploration and surprise - what might be called the ambient findability of the city – are not considered. In the Radiant City, no one, while walking from their residence, will bump into a factory worker, a civic functionary or a management worker. New information gathered will only be about other people whose lives are centred on the residence.

Organisation by modularisation is specifically carried out in order to “limit the potential for interaction between the subsystems” (Green et al., 2006:65), especially by engineers as the unpredictable, emergent patterns arising from the interactions can interfere with the planned results. Such segregation of the city reduces complexity and emergent behaviour. Salingaros, an applied mathematician, criticises the Radiant City on the basis of preventing diversity of interaction (Salingaros, 2004:26).

Modularity, especially a hierarchy of modules, creates brittleness in a system (Green et al, 2006:65). Clumping elements into a module and then connecting that module to the system means any damage to the link dis-

connects the entire module. According to the omnivory principle, the more pathways of connections between the subsystems and the main system, the more stable the system will be. (Skyttner, 2005:102).

Modularity, as above, is used by engineers when emergence can ruin the desired results of their system. But what are the ‘results’ of the city? The result of the city might be a type of learning, with the city as an evolving device. The idea that the accidental and the unexpected contribute

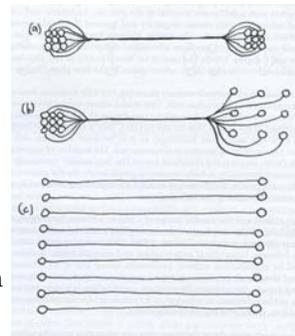


Figure 14 Salingaros diagram of Radiant city connections, showing that modules can be connected in the same way, whether the forms are close in space or distant (Salingaros, 2005:26)

to the qualities of urbanity is championed by Maller in his argument for congestion as a creator of 'structured accidentalness' (Maller, 1999).

Structured accidentalness or ambient findability is interesting because of the role it plays in creating new knowledge. If we look for information where we expect to find it, we advance our knowledge in a stepwise fashion as we work through the web of ideas. Finding information and creating new knowledge in a multiply connected web can occur at different speeds. Random multiple connections enable paths through the network that would otherwise be unbearably slow taken step by step in

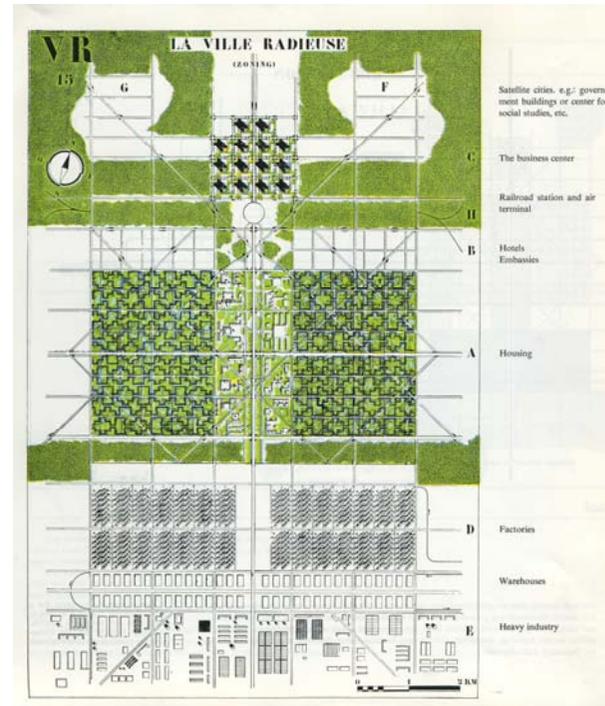


Figure 15 The Radiant City – all functions separated

a simply connected network.

Activating this process is akin to finding a much more exciting book on the library shelf that is next to the one you were actually looking for, or clicking through the internet and finding unexpectedly helpful web pages. Spatial design and organisation contribute to the type of connections in a system. Objects (or agents) can be conceptually distant yet physically adjacent, so their adjacency in space has created a 'random' link connecting them in a different way to their conceptual link.

Alternatively, objects/agents can be organised in space in line with their conceptual links. This type of spatial organisation maintains the same number and ordering of links as the conceptual system. In this way, the spatial organisation does not increase the complexity of the system.

This is the type of ordering Le Corbusier makes in the Radiant City: reducing the number of links in the city through aligning the conceptual and the physical linking of parts of the city.

The problems with this modularizing of the city are explained further by the sub-optimization principle. A design principle of dividing the city into modules, into sub-networks, and optimising these individually was discussed above. The reason this fails to optimize the entire network is:

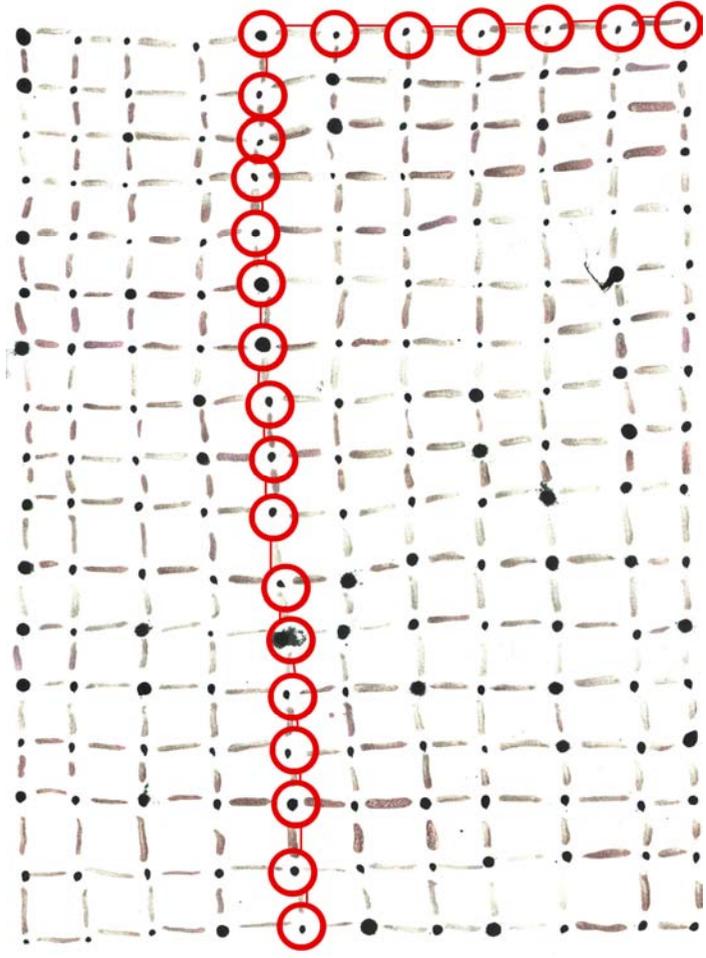
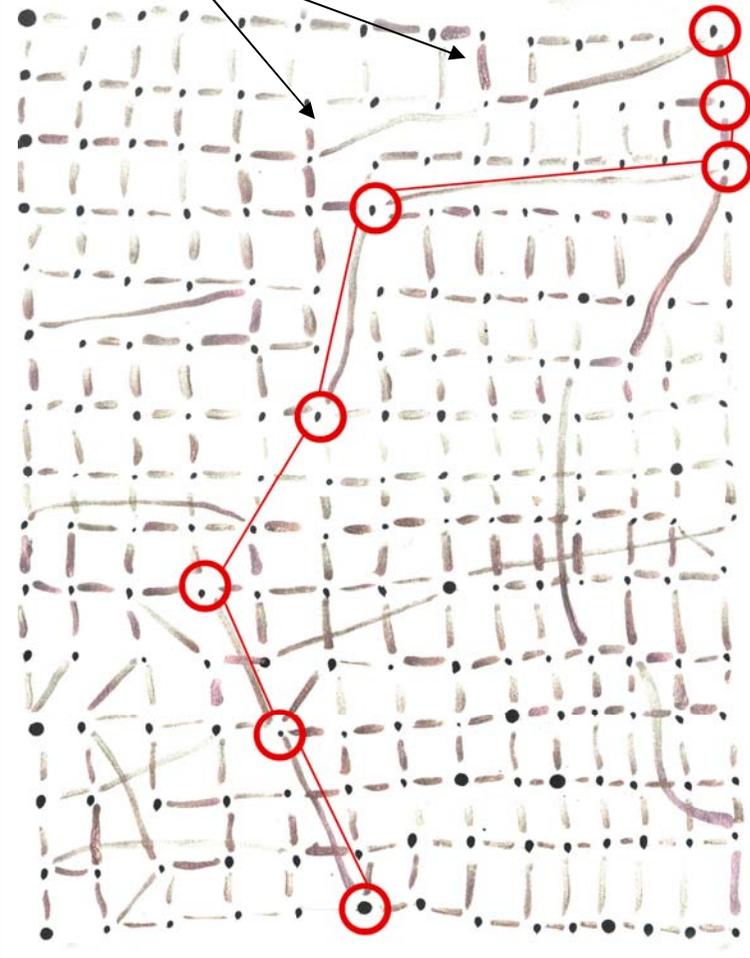


Figure 16 A 'walk' , or path through an network with ordered connections. This takes many more steps than...

Connections from ordered network are broken and randomly reconnected



...it does through the same network that has had random connections added: a small world network

By isolating the sub-networks we are closing them; they are no longer open. As such, once the sub-network is moving on a particular attractor it will then cycle through a fixed number of states in the same order forever more. The system certainly can't move from one attractor to another. However, once the sub-network is connected to an 'environment' rather more complex behaviours can occur. Furthermore, new attractor hybrids become available through the interaction with 'the outside world' as 'information' flows through longer period feedback loops, and as more loops interact with each other in non-trivial ways
(Richardson, 2005:107-108)

Hierarchy

Top-down design had the appearance of masterfulness, of taking control and creating action in a chaotic and disorganised world.

In *The Radiant City*, Le Corbusier revels in the personal pronoun, emphasising his own vision being applied to the city rather than a collaborative, consultative approach.

"I submitted an overall plan...I created a 'radiant city'...I provided for the 'basic pleasures'"(Le Corbusier

1933:13).

He doesn't seem to doubt that he is at the 'top' either. The 'other' inhabitants of the city are as children "Look at the misery, the unhappiness and stupidity. People behave like children, negatively and destructively, without meaning to" (Le Corbusier, 1933:6). Whereas he is a clear minded professional: "Since I am a professional man, I make plans according to my professional concepts; this is where my judgment is good" (Le Corbusier, 1933:8). Furthermore, he quotes a CAIM document calling for a hierarchical decision making body and person-

There is no central agency to guide

and correlate the analyses which must be made and the initiatives which must be undertaken. There is general confusion, chaos prevails, danger is everywhere. It is imperative that in every country or region there be a plan to create a permanent agency, directed by a competent and responsible figure, able to give the country its new statute. (Le Corbusier, 1933:23)

Le Corbusier recommends dealing with chaos by striking at it surgically: "...[C]ity planners will be guided in their layouts by the so-called 'surgical' principle (layouts cutting across existing streets and blocks or boundaries), instead of the 'medical' principal (aiming merely to widen existing streets or roads)" (Le Corbusier, 1933:24). Cutting in this way can sever connections between residents of the city (Halsted, 1999). On the other hand, I hypothesise that the cuts Hausman created through Paris converted Paris from a

very tightly clustered city, where inhabitants lived their lives very much in their own locale, changing the structuring of interaction from a clustered network to a small-world networked. The boulevards functioned like 'random' connections, allowing new connections between what were far flung clusters.

Le Corbusier saw what might be described as an emergent phenomena arising from the social interactions of the city and he associated them correctly with the intensity of the street. But it seems he could only believe that as an individual designer, he could work so much more efficiently than any group could. Complexity theory, of course, understands that agents within any system can not have global knowledge of that system, and therefore central acts of control (in the case of this thesis, design) are illusions, or indeed disasters (Schuster, 2004).

In Paris I often walked through the district bounded by the Place des Vosges and the Stock Exchange - the worst

district in the city and the most wretchedly overcrowded. Along the streets, on the skimpily sidewalks, the population moves in single file. By some miracle of group identification and the spirit of the city,

even here people laugh and manage to get along, *even here* they tell jokes and have a good time, *even here* they make out!"

(Corbusier, 1933:12)

Observation is an important tool, but here Le Corbusier has observed an intensity of interactions on the street and an accompanying pleasure, even possible emergent phenomena (the spirit of the city). At the same time he rejects the strength of his observation as pertinent because it does not fit his theory. It seems as if anything not under his control must be eliminated. He devotes a section of *The Radiant City* to 'The death of the street' (1933:119-127).

Successful application of science seems to rest on a power of observation, an ability to notice events/activities that do not fit in the prevailing paradigm, and the exploration of those observed events. This seems to parallel the way artists and designers often work, often perhaps this observation of events outside the paradigm is where there is a unity of approach in the 'arts' and the 'sciences.'

Few people today would agree with Le

Corbusier or adopt his principles, but due to the sedimentary effects, the historical embedding of mineralised processes in the morphology of the city, those who have been inspired by Le Corbusier have embedded his thinking into the city.

What has resulted has not just been the well-documented break-down of social order, the self-organising system of local culture in modernist urban developments. The attempt to 'do good', to make better places has been given a bad

name in design. The curse of 'determinist design' really means 'reductionist design.'

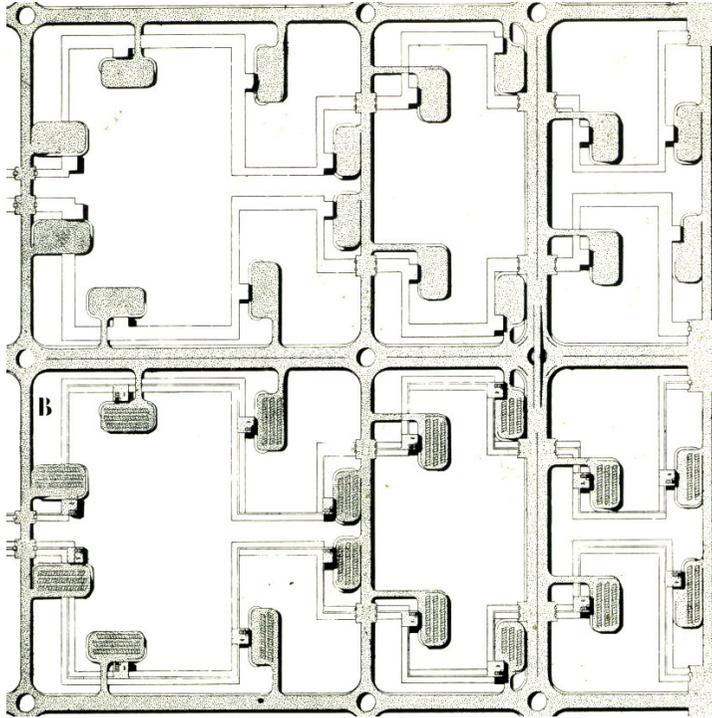


Figure 17 The Radiant City:
replacing streets with garages



Figure 18 Hulme:
replacing streets with deck access

On Hulme, Manchester

Deck access apartment blocks built in Hulme in the early nineteen seventies separated the walker and driver. The design of Hulme is different from the Radiant City, but the effects of changing social interactions on the local order, is well documented. Deck access was intended to privilege the walker, raising them above the noise and exhaust of the car, and the housing was sited

away from the roads. Problems of crime and vandalism surfaced immediately and grew exponentially (Moobela, 2005:37). Seventy- five percent of crimes were committed on the decks (Moobela, 2005:38). The initial failure of Hulme is attributed to breaking up the existing social networks (Moobela, 2005:37) and the continuing problems can be blamed on the segregating effect of a deck access system that continuously reduced social interactions. Moobela sees the current regeneration of Hulme as an example of complexity in planning; 'problems' were reversed by real tenant involvement in the decision making process that was definitely bottom-up rather than top-down. Descriptions of the tenants give the impression these were people with few illusions of having access to (illusory) central control. Moobela describes the planning process as being brought to the edge of chaos by this change in control.

The solution the tenants decided on was complete destruction of the deck access

housing (Moobela, 2005:39). The built form that seems to have destroyed the social order it was meant to house was in turn destroyed by the social order—a mutually destructive morpho-ecology.

4
Mineralization of the positive negative
feedback causality principle
or,
The history of the road

Negative/positive feedback principle

Given negative feedback, a system's equilibrium state is invariant over a wide range of initial conditions. (Skyttner, 2005: 101)

This characteristic is also known as equifinality, and basically suggests that a system's phase space contains basins of attraction. ... Negative feedback is the mechanism by which phase space is carved-up into different regions of attraction... the "wide range of initial conditions" all of which eventually end up on the same attractor; many different starting points end up in the same place; or, there are many ways to achieve the same ends...

Equifinality ensures that many starting points will take us to the same end point. Multi-finality (or the positive feedback causality principle) ensures that the same starting point will lead us to many different end points. ... Moreover, in such systems the structure of phase space can evolve which, will change the number and nature of the available attractors. ...the set of attractors for a complex adaptive system can evolve over time (the system actually becomes a different system from that which it started). As such the same initial conditions can evolve into different systems with different phase spaces.

(Richardson, 2005:111)

If there are more vehicles in the world today and if they are travelling faster than ever before, then it is partly because the world's roads have never been so smooth, so well made and so wide. (Schreiber, 1961:278)

I have also examined the ordering of movement through traffic engineering. To criticize this sincere, deeply well meaning discipline seems perverse, as if I am suggesting that the tragedy of road deaths is something that need not be prevented. But reductionism has been applied to the process of movement, a city creating process, and an approach has been mineralized. And complexity researchers are not allowed to run from perverse approaches.

The effect of the road and the car on the large scale morphology of the city is fairly well documented. Works such as *Streets and the shaping of towns and cities* (Southworth and Ben-Joseph, 2003) and *Suburban nation: the rise of sprawl and the decline of the American dream* (Duany et al., 2000) link the process of driving and the shape of the city.

In this section I look at a subsystem of this city-making system, an approach that considers the next level down in the nested loops of interactions between the space of the street/road itself and the interaction

Figure 19 Railway network structure functioning as map and diagram



between space and process. Instead of a top-down vision intended to order the city by modularisation, traffic planning/engineering has worked with a strategy of standardising movement. The current form of the street is a mineralization of historical processes and feedbacks. In this section I sift through the history of these feedbacks and the processes that have created the roads that run through our cities.

The design of the road-- its size, shape, surface and direction-- influence our decisions on how, when or whether to travel. An individual's decision about how they travel influences decisions on what roads are needed, and where. Feedback between governments and society determine the direction of the evolution of the road structure. The mineralization of this morpho-ecological structure embeds this history and shapes future processes.

A history of segregation by speed

In the Europe and America of the nineteenth century, railways were economically catalysing connectors. The network structure of rail is explicit on rail form: low connectivity and large, dense nodes of stations. This network was so important that there was little investment in the highly distributed, highly connected road network.

The invention and popularity of the bicycle meant that cyclists begged govern-

governments in Europe for improvement to the road surface, with little response (Schreiber, 1961:215).

The first cars to be driven were alarming to the general public and as a result, required someone to run in front of them with a red flag to warn others of approaching danger.

Feedback: military power

World War One changed the role of the car. Previously, cars were rich men's toys; now the car was a serious tool (Schreiber, 1961:219). The war "had consumed more motor vehicles than all the countries in the world had possessed up to 1914, but, for all the lives the machines had destroyed, it had at least proved the worth of the motor car..." (Schreiber, 1961:219). Cars and other motor vehicles gave armies the advantage of movement networks that were dispersed and flexible in both time and space. The car network is less centralised than the train network and therefore more robust under attack, a quality of all de-centralised networks (Barabási, 2002, Skyttner, 2005). These network characteristics continue to shape both contemporary car use and contemporary warfare. The decentralised networks of Al-Qaeda, for example, give the organisation a resil-

ience that centralised military networks seem to lack (Gunaratna, 2002:95).

Huge amounts of money are needed to build car worthy roads and:

...in the early stages there often seemed to be only one possible method of wheedling these enormous funds out of parliaments and budgets: the authorities concerned had to be persuaded that good roads were a military necessity... the road was

open to all and seemed therefore ideally suited to 'the conquest of space' . (Schreiber, 1961:231)

In a final feedback to creating highly dispersed, and therefore road dependent cities, was a cold war belief that an "increasingly horizontal network of communication and transportation lines, was an instrument not merely of civil defence against an external enemy but of defence against an internal one: the disorder that was anticipated with the demise of centralized governmental and civic authority..." (Martin, 2003:7).

The introduction of modularisation

Because cars *can* go fast, Le Corbusier believed it was only logical that they *must* go fast all the time. "Now, all modern motor vehicles are constructed for speed...The motor factories (national industries) struggle hard to attain speeds of sixty miles an hour and over, but the existing conditions in our towns keep us down, perforce, to ten miles an hour!" (Le Corbusier, 1929:119-120). Speed necessitated adaptation simply because it existed. Besotted with the power of the car, he writes, "Motors in all directions, going at all speeds. I was overwhelmed, an enthusiastic rapture filled me. Not the rapture of the shining coachwork under the gleaming lights, but the rapture of power" (Le Corbusier, 1929:xxiii). Le Corbusier requires rapture as well as speed from the city. Just as Le Corbusier modularized and divided the functions of living, so too was traffic categorized. Traffic is

sorted into three modules: heavy traffic, light goods traffic and fast traffic (Le Corbusier, 1929:168).

The desire to modularize walking, to completely segregate it from driving had already been made at the International Road Congress of Seville of 1923, which called for "crossing-free roads, or crossings with a clear view of at least a hundred yards" (Schreiber, 1961: 220).

Feedback: status

The car has long been associated with status and masculinity and in the early half of the twentieth century car ownership was more firmly in the hands of the wealthy and the male. The streets of the city were occupied by walkers; by those with less status and power than the drivers. Early photographs of streets show people walking over the entire surface of the streets. They were, however, preventing the exercise of power, the exercise of speed that so intoxicated Le Corbusier. A top-down control of these chaotic, unruly elements was needed. The continuing work of keeping walkers out

of the way drivers, of allowing drivers the privilege of speed in the city, must be associated with the disparity in status between the two groups.

It seems the desire to organise the life of the street was a strong force. In the early twentieth century, playgrounds were invented to segregate children from the 'anarchy' of the street and socialising them in a way that was 'under control' (Hart, 2002:135), helping ensure the streets had a unitary purpose.

Feedback: money

In the 1930s another factor drove the governments to spend the enormous sums required for car-worthy road to be built - the Great Depression. Road building soaked up the surplus of labour (Schreiber, 1961:222) to serve an economic and social gain and establish a symbiotic relationship between the

road, the car and the economy. As governing bodies were willing to build roads suitable for cars, so too were people willing to buy cars to utilise this infrastructure. Industries responded by manufacturing more cars. The car industry, particularly in America, contributed to huge economic boom, which governments were keen to encourage – through the building of more car-oriented roads.

"For a variety of reasons several branches of industry in the U.S.A. and other countries were

interested in building new motorways:...an efficient road-system increases the demand for cars, there are fewer accidents on the motorways than on ordinary roads, and they encourage the tourist trade" (Schreiber, 1961:224-225). The sheer mass of goods bought home by the car swarms that brought home by a consumer walking or using public transportation.

The way transportation changes patterns of consumption still shapes the economy. British supermarkets trying to break into the American market have to adjust their type and volume of stock- the car encourages buying more bulk, frozen and tinned foods, while public transport users buy more fresh foods, more frequently (*The Economist Magazine*, 23 June 2007:77-79).

In Wellington, the economic benefits of car sales to one individual helped shape the transportation network. Councillor Anthel, a car dealer, headed the transport com-

Figure 20
Walking on
Lambton Quay
in the 1920s



committee that removed New Zealand's last running trams from the streets. He is pictured waving off the last tram " a cigar between his teeth" (Yska, 2006:181-182).

Geographer John Adams points out the continuing mismatch in the feedback loops informing the system of road development:

The rewards of motoring are also reduced to monetized abstractions. In their cost-benefit analyses of their road building projects, the principle benefit is time-saving for motorists. Motorists are wealthier than those without cars and their time is worth more... People without cars are economically inferior; their concerns barely register in the cost-benefit calculations of the Department of Transport. In the formalizing of their decision making procedures, both the convenience and safety of people in cars are accorded greater significance than the welfare of people outside cars. (Adams, 1995:156).

People using public transport and/or walking are not only likely to be poorer than those with cars, but the way space has been shaped by the road and the car means that people without cars are more likely to stay poor. Without a car, more time, effort and (often) money must be expended to travel the same distance (Larsen et al., 2006:53), leaving the car-less with less

ability to earn their way out of their situation.

The feedback loops for driving and walking are different. Feedback loops are necessary mechanisms in the evolution of self-adaptive systems (Kauffman, 1995).

The personal positive feedback from driving is immediate. You are encased in comfort, arrive dry and tidy. The personal negative feedback is slow and accumulates over time, making it hard to perceive and act on. Driving is a seden-

tary, and ill health from sedentary lifestyles comes slowly.

The walker has the immediate feedback of arriving at their destination with sore feet, maybe wet, and tired from carrying stuff. Their long term feedbacks, the benefits to physical and mental health, are slow to arrive.

The wider feedback- from society, the tax system and so on- is also different, distorted. The car emits pollution that kills around four hundred per year in New Zealand (Fisher et al., 2002:1), but there is no path for negative feedback to the individual driver. The response to congestion is often to spend more money on roading, giving positive feedback to the driving system. Car marketing thrives on the positive feedback loop between vehicles and the consumer, evolving more and more seductive cars.

The ways in which these and other feedbacks and interactions construct the material of the road system are discussed as a mineralization of a complex system next.

By the nineteen sixties planning commissions took for granted that cars must run smoothly through the city. In fact, traffic planning was understood as a celebration of flowing.

Desired outcome: flow

The influential *Traffic in towns* completely dismisses buses or trains from consideration in the planning process. "Events have passed far beyond the point at which it would have been possible to revert to railways, though doubtless some loads could even now be transferred to them with advantage." (Buchanon, 1963:31). Walking is considered very carefully and among his recommendations (a thread to be picked up in chapter eight) is the complete modularisation of walking, based on an comparison with Venice, which has:

an interdependent system of vehicular and pedestrian ways can be contrived with complete physical separation between the two - so complete that they do not even seem to be-

long to the same order - and that it works (Buchanon, 1963:224)

More than traffic modularization occurs in the Venice movement form/movement system. The speed limit for boats on the canals is five miles per hour. Perhaps this is important to Venice's success, with the pace of motorized vehicles in sympathy with the pace of the human body. In Venice the module of walking-only space is three times the area of the vehicle only module (Buchanon, 1963:221). In the car cities these ratios are likely to be reversed.

Missing in this car-vehicle: boat-vehicle comparison are the sensory responses to water; asphalt does not compare well for sitting next to and staring out at, for dipping your fingers into as you move over it, for the sound of waves or the reflection of light. And kissing on a pedestrian bridge over a motorway is not quite as romantic as it is over a canal in Venice.

The morpho-ecological principles of the traffic/urban system are noticed during the nineteen sixties, but are not credited. Buchanan finds it hard to believe that more roads lead to more traffic but simultaneously seems to admit that roads lead to sprawl and thus to traffic.

Other people say that freeways 'never solve the problem' because they become congested as fast as they are built. This, however, does not always seem to be the fault of the freeway; it is often the fault of continuing sprawl (admittedly often sparked off by the construction of the freeway) which brings new loads of traffic. (Buchanan, 1963:229)

The pursuit of ultimate flow, some potential state where every vehicle can slide through the road without meeting any impediments ever, are the themes of other traffic engineering manuals of the sixties. "In the cities of the future", envisaged in 1961, "there will be no room on the road for buses, trams and pedestrian crossings" (Schreiber, 1961:289).

Traffic planning continued with the focus on vehicles: in the nine-

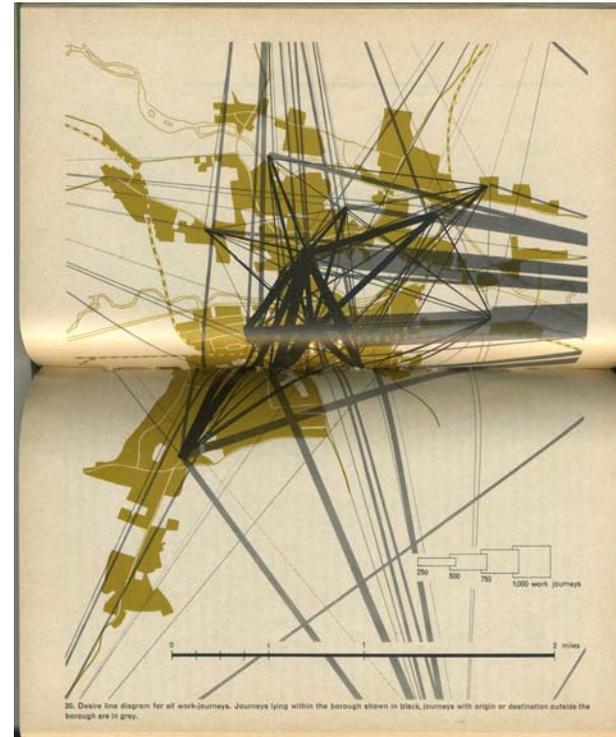


Figure 21 Traffic planning diagram by Buchanan

'Desire lines' cutting the city

nineteen seventies Shinar starts with the initial simplification that there are no pedestrians (Shinar, 1978:2).

Speed is the companion of flow. The difference higher speeds make to travel time is slight. Over a 10 kilometer trip, a drop from 50kph to 45kph saves only 1.20 seconds (Patterson et al., 2001:61).

Yet simple flow should not be the one and only Holy Grail of cities. It is not the flow in itself that creates the city, but the interactions that occur that are facilitated by that flow. De Landa points out that it is often the friction rather than the flow that results in self-organization, in the form of "delays, bottlenecks, conflict" (De Landa, 1997:41).

Figure 22 The first traffic lights in Wellington 1951



Feedback; fear

Risk is a cultural construct (Adams, 1995), and the perception of risk constructed around the road/car/walking make a fascinating and important feedback loop to the design and ordering of the street.

The paradox of risk perception is especially apparent when flying and driving are compared:

“... the public rather readily accepts individuals killing themselves in their own automobiles, but views airline safety in a very different way” (Shulze, 1980:218).

Yet the risk cars pose has not been hidden or minimised; the risks cars present to those walking has been, and continues to be, a tool to coerce the walker to contain their movements in space and time.

Programmes of pedestrian safety, or fear of the car, have been shaping walked process since the nineteen fifties. The message of the two following educational advertisements is that walkers must not trespass on the carriageway, a warning that death by car is a natural consequence of this action.

Fear becomes a tool to keep the walker in the narrow field of the footpath, temporarily allowed onto the carriageway only when the signal flashes the figure of a ‘green man’.



Figure 23

Figure 24 stop look live campaign



Fear is still used to keep walkers within their allotted space. A campaign current in Wellington paints the footpath with “Stop Look Live” accompanied by outlines of bodies in the road.

This advertisement has a high impact with its highly saturated colours, the faux child’ perspective and with almost celebrated bloody body parts. In what is called an availability heuristic, events are judged more likely if they are easy to imagine, and vivid films, for example, will make this imagining more likely (Slovic et al., 1980:183).



Figure 25 'Speed kills kids' advertisement in Sunday Star Times

Aimed at the driver, advertisements like the one from the Sunday Star Times have other interpretations and unexpected effects.

What did I feel on viewing this advertisement? I believe I already drive very carefully next to schools, and think there is not much more I can do to improve it. There is an imbalance in the perception of voluntary risks (driving is a voluntary risk) and involuntary risks (being run over by a careless driver); the voluntary risk has been estimated to be one thousand times more acceptable than involuntary risk (Slovic et al., 1980:183). I am also the mother of two children, and one feeling I had while looking at this was that I must be even more careful of my children so they don't end up like the broken, dead child in the picture. My dread of this fate for them was fully engaged, and I already worry a great deal about them being run over. It is easy to see there would be a point where this fear for their safety, as a result of campaigns like this, increases to the level where I felt the best thing for my children would be to drive them to school, in order to save them from being run over on the way.

Potential run-on effects from this decision include my children arguably becoming less fit. If they are less fit, they will find walking more difficult and avoid walking in other circumstances. They will be less en-

engaged with their surrounding neighbourhood and people in it. Neighbours will become somewhat more like strangers and fear of the unknown will make a retreat to the interior of the car more appealing.

Such events would inevitably spur increased traffic around the school in turn increasing the perception other parents have of the dangers to their own children. They potentially become more likely to drive *their* children to school. Engwicht explores this paradox as well, in *Mental*

Speed Bumps (Engwicht, 2005:95-107).

Taken together with a fear of sexual predators – a sole child walking to school could be seen as more at risk than a child walking with a group of their friends, or on a street full of walking children – a complexity effect can occur. A slight change in perception, iterated many times over many travel decisions by many people, leads to an attractor forming; an attractor state where so many children are driven to school that it does, in fact, become a lot more dangerous to walk to school.

This pattern has emerged in England, where children have been found to be less exposed to the street than other generations were because of parents' perceived fear of traffic (Adams, 1995:13).

This is an attractor developing in the vehicle/walking system based around schools and fear, but other attractors can develop in transport systems. The most deeply

ironic of these was one I experienced in Taipei in the nineteen eighties and is present in cities like Bangkok today. The exhaust from the huge number of cars on the street is so unpleasant (and in fact dangerous) that walking and breathing on the street becomes painful. The only escape, when public transport is limited, is to get into a car with a filtered air conditioning system, and so, ironically, contribute to increasing the level of pollution of the streets.

Feedback and the car body

The majority of SUV (sport utility vehicle) owners say they choose one for safety's sake, a perception brought on by the higher seating and greater mass, although the kill rate of SUVs is higher for those both inside and outside the vehicle (Vanderheiden, 2006:30-31). As SUV sales continue to rise, it seems that automobiles are evolving in a response to perceived safety, while evolving away from actual safety.

Status is already a feedback for the evolution of the car body. Using the SUV as an example again, consumer research SUV buyers are more self-oriented and

image conscious than other car buyers (Vanderheiden, 2006:32). Aggression and power drive SUV buyer/designers feedback loops to create vehicles like the Dodge Durango, described by designer Clotaire Rapaille :“ ... a strong animal has a big jaw, that’s why we put on big fenders’ “CR quoted in (Vanderheiden, 2006:32). Car marketers amplify again the feedback loops by downplaying the safety features and emphasising speed and power in advertising (Wilson, 2007). Again, these slight changes in perception can iterate to create an attractor in the system. In roads filled with large, snarling beast-cars, it becomes not just a perception of safety that would drive the decision to buy an SUV rather than a smart car. This change in the car system then links to the walking process, increasing both walkers perceptions that SUVs are more risky (aided by advertising that emphasises the ‘beast like’ nature of these vehicles) and the reality of risk as evidenced by statistics.

John Adams argues that “protecting car occupants from the consequences of bad driving encourages bad driving” (Adams, 1982:2824).



Figure 26 Dodge Durango

Citing seatbelts as examples, he argues that because people felt more protected when seat belts were introduced there was no eventual change in the accident rate because drivers took more risks with their driving style because of the impression of greater protection seatbelts given by seatbelts. He extends this argument to the introduction of air bags.

Morpho-ecology of walking

People are attracted to these [stimulating] streets. If they were

not they would go elsewhere. They would go to the streets with a very low degree of stimulation: the streets that are lined with blank walls and unencumbered with activities. Pedestrian counts show that people do not use such streets save for necessity. (Whyte, 1998:66)

As the process of driving creates the sedimentation of a system around it, so too the process of walking sediments form. The pedestrianisation of Cuba St in Wellington happened after the street was temporarily closed to traffic in 1955. Shop keepers noticed such a rise in custom that they lobbied for the street to be permanently closed to traffic. With no legal path for this to happen, it took until 1969 for the street to be permanently closed to traffic. This change in structure continued to catalyse a change in process: pedestrian numbers in Cuba St went up 50 per cent.

(Town and Country Planning Division, 1977:31). At first only one block of Cuba was closed to traffic, but the success of adapting the form of one block meant that pedestrianisation spread up Cuba St and along Manners St.

Summary

Each step in this evolution of a road/car system has just been a small step 'needed' to improve vehicle flow and safety. Current develop-

ments, such as smarter traffic systems, computerised, response, linked to GIS information on exactly where this minutes' traffic jams are, represent extensions of this process and are likely to create the same sorts of feedbacks that lead to complexity related problems that are present in the current traffic system.

The more effort we put into this palimpsest of a traffic system, the more importance we are placing on vehicle flow. We are further investing in this feedback loop. This means we are agreeing that vehicle flow is the most important part of our traffic system, in an age when we know that vehicles account for a significant amount of the world's greenhouse emissions.

We seem to have an inbuilt heuristic that guides us toward choices that provoke a *perception* of safety rather than an inbuilt statistician giving us the actual odds. (Pidgeon et al., 2003, Adams, 1995) Together with a tendency to choose increased risk for others

over increased risk for ourselves and the tendency for riskier behaviour when we perceive environmental safety, a paradoxical system has evolved. Perception of risk creates a negative feedback in the evolution of road and car form that can be divorced from risk reduction – and this perception has the potential to increase risky behaviour. We need to step aside from the morphological carapace that has evolved under feedbacks that include chimeras of safety and expressions of economic and military power.

Because complex systems retain a history of events in their structure, we are living with a road/car system that maintains and perpetuates this history. "The nature of these connections is a result of which states of the network are 'retained', thus the structure of the system is a result of the sedimented history of the system" (Cilliers, 2006:108).

The evolution of the road/traffic system is rarely examined or critiqued. The idea of removing all the effects of this modularization of movement is rare. Yet the approach of movement modularization brings up questions of brittleness in the system again, as well as the sub-optimization of the sub-networks.

Designs that critique traffic engineering will be discussed in chapter eight. I now move to discussions of whether the design approaches outlined in the last two chapters have damaged cities, and some beliefs on how to deal with the 'problems' of the city.

5

**The redundancy of central command
or,
Has the city been sub-optimized?**

Redundancy of potential command principle

In any complex decision network, the potential to act effectively is conferred by an adequate concatenation of information.

Essentially this means that to 'control' a complex system we must at first have a sufficiently good representation of it, so that we can design our controlling actions such that our desired effects will follow as a direct consequence. The task of constructing such a "sufficiently good representation" is problematic when we are concerned with complex systems. Part of the reason for this is that any representation is by necessity an abstraction, and abstractions are incomplete. Such incompleteness always leaves open the possibility, because of sensitivity to initial conditions (context), that our basis for taking action might be (sometimes wildly) inaccurate. This is true even if the 'real' system is a closed system--slightly incomplete descriptions do not necessarily lead to slightly incomplete understanding. A related reason results from the fact that even if the description of the open system itself is complete (which is rarely the case anyway), it is practically impossible to have a complete description of the environment within which the open system of interest operates.

(Richardson, 2005:109)

Central planning has certainly historically been applied to many existing cities. Planners are, of course, now aware of the problems of central control revealed by complexity theory (Moobela, 2005), but the form of the city has been (to varying degrees) created by the ideas of central control. These sedimentations of the central planning/traffic planning now mould current city processes. Has the resultant city been sub-optimized? Debate on this has ensued from Jane Jacobs work, *The death and life of the great American cities* (1961).

The problems of traffic planning are aligned to the problems of the top-down sub-optimization principle. As I discussed in the last chapter, Le Corbusier invoked the bottom-up sub-optimization principle by dividing the city into sub-networks and attempting to optimize those, damaging global optimization. To invoke top-down sub-optimization, one “identifies which nodes and connections do not contribute to the overall functionality of the network of sub-networks rather than the functionality of each sub-network” (Richardson, 2005:106). The results of this are to de-optimize the sub-networks (Richardson, 2005). I see the translation of this strategy into traffic planning to optimize flow throughout the city leading to the sub-optimization of the sub-network, the street. Even more harmfully, in seeking to optimize

flow via speed, we sub-optimize the sub-network of the city that is the individual person. The 'acceptable' number of road deaths resulting from speed is the tragic sub-optimization of a life. Schreiber's response to the problem of road deaths is that "these accidents are tragic but inevitable by-products of something that is a valuable public service and they cannot be eradicated without reducing the quality of that service" (Schreiber, 1961:229).

Questions about how well our traffic or-

dering devices actually work are hardly heard, yet studies have found that pedestrian signals make no difference to accident rates (Zeeger, 1993:193). More so, the accident rates are *worse* on marked pedestrian crossings compared to unmarked crossings (Shinar, 1978:181). In Florida, a corner called 'confusion corner' was believed to be unsafe because it didn't comply with Department of Transport (D.O.T.) regulations. However, it had been the site of only one accident in its history and the most dangerous sites were those that actually complied with D.O.T. regulations (Duany et al., 2000:306-307).

The question of whether or not the city has been damaged by privileging traffic planning is a question that is difficult to disentangle from questions of nostalgia. Cities that have not been optimised for traffic flow are usually either historically 'well-preserved' European cities or alternatively cities in poorer countries that cannot afford the expense of traffic infrastructure.



Figure 27 Shanghai, Alastar Gordon

Comparisons- claims that the contemporary city is less than it could be- or should be, are at risk of being blurred by the conditions of the contrasting city.

Is praise for a traditional European city, one that appears to have been only slightly adapted to traffic flow, praise for the way the processes of driving have been integrated into the city or praise for the traditional built form?

Cities in developing countries can also be only slightly adapted to driving when cars are rare and infrastructure expensive. Illustrated here is Shanghai. Traffic of all kinds, trishaws, scooters, walkers, jeeps and hand-carts finds its way through subtle negotiations that are a mystery to the tourist. One can easily feel rather like Le Corbusier, puzzled that anyone can cope with the swirling 'chaos' of the streets. Alternatively, one can be charmed by the local 'colour' of the street. Will it ever be possible to separate either of these responses from a 'first' world paternalism or a romantic 'noble savage' interpretation?

Jane Jacobs critiqued urban modernisation as a complexist; she links city processes to organisational complexity (1961:432), and points out the faulty assumption that the city's problems are linear problems

(1961:433-435). This work places Jacobs as a pioneer of complexity thinking. Jacobs observes peace as an emergent property, as "kept primarily by an intricate, almost unconscious, network of voluntary controls and standards among the people themselves" (Jacobs, 1961:32). This is saying that bottom up interactions between the people create the order of public peace.

Jacobs then gives a full description of the pattern making of the complex system of the city.

Under the seeming disorder of the old city, wherever the old city is working successfully, is a marvelous order for maintaining the safety of the streets and the freedom of the city. It is a complex order ... (Jacobs, 1961:50)

Jacobs is criticised as romantic and nostalgic by Elizabeth Wilson (1995:4) and by Dejan Sudjic. (1992:23) who finds her work so nostalgic he compares her to a pioneer from the Old West, with a “corny vision of Utopia” (1992:25).

The existing logic of reductionism could not explain the seemingly counter-rational behaviour of cities. Observation over time could allow the insight, for example, that increasing the size of roads will not stop traffic jams, instead traffic density will increase to fill all the new roads as well (a typical ‘unexpected’ complexity result) and there are *more* jams not less.

New Urbanism

New Urbanists ideas are all subject to the criticism that they are nostalgic, deterministic, backward looking and do not deal with the urban condition as it is today.

Suburban nation: the rise of sprawl and the decline of the American dream describes space lacking in interaction:

In an architectural version of *Invasion of the Body Snatchers*, our main streets and neighbourhoods have been replaced by alien substitutes, similar but not the same (Duany et al., 2000:xiii)

The authors carry on to say that lack of “public discourse” is being responsible for this what. I find their vision of the spaces as somehow absent of an equivalent of the human spirit or consciousness particularly interesting. This is an expression of the idea that the combination of form and process can generate something else, some difficult to express, untouchable meaning. I look further at how this ‘meaning’ might



Figure 28 Brussels , Alastair Gordon

be arrived at or described in chapter ten. While the work in this book places great emphasis on walking and walkability, there is also a great deal of emphasis placed on form. Duany and Plater-Zybeck often look to historical examples as guidelines for finding form. The logic of this approach, based on the hypothesis that historical cities have some richness that is lacking in contemporary sprawl, is positive in that it recognises the worth in cities that have emerged through self-organising behaviour, a thought with which I agree. But their solution, to graft the forms of historical cities onto contemporary cities is not an answer. A particular example of this is where they explain

the “precise standards” that could be coded to create a square. It must have trees at the edge; it must have grass for sports and so on, all standards “carefully derived from proven models” (Duany et al., 2000:33). The assumption here seems to be that because this form appeared in cities that are ‘good’, the typology will prove to be ‘good’ over and over, in any situation.

A core concept of complexity theory holds here for urban design: the principle of folded phase space holds that returning selected variables in one phase space to the way they were in an earlier state does not return the system as a whole to the way it was. Processes have changed, interactions have changed, and how these are changed needs to be considered as much as form needs to be considered.

The argument is often made that building cities with lots of opportunities for interaction will be good for community creation

Rather optimistically Appleyard and Jacobs believe a city with plentiful community interaction will work somehow in the manner of a Constitution, bringing not only justice and tolerance but also democracy (1996:442). The argument I make for the design of an infrastructure of interaction is not about creating some sort of nice, caring community that will emerge from these interactions, although a nice, caring community may be one possible result of an effective infrastructure of interaction. Interaction does not ensure

that 'good' or caring cities and communities will emerge. Evil can be an emergent property of systems (Bella, 2006).

Salingaros, too, believes traditional urban forms can be adopted to good effect, because they represent the mineralised intelligence of many minds; hundreds of years of adaptive built form, an evolutionary process where forms that didn't work were eliminated, those that did were replicated (2004:229). This is an interesting argument and given Salingaros' work as a mathematician rather than a design professional, has a stronger complexity rationale than new urbanist thinking. But the same counter argument applies - that processes are different in contemporary cities and societies and so traditional forms need to be re-examined in these terms for contemporary use. It would also be helpful to consider *which* aspect of the form affects interaction. Rather than reproducing all the, say, fluted columns and statues of heroes that exist in a traditional square,

exactly which aspect of form is affecting the processes that are valued, or regarded as missing in a contemporary design,

I am not suggesting this approach can never work. The discussion that follows in this thesis is about adopting a spatial organisation that embraces many historical manifestations. In contemporary use, however, the interactions that take place in the city are quite different to the interactions that existed in the past.

If cities are material accretions/secretions based on their flows, (De Landa 1997) differing flows would mineralise different cities. I think that a desire to recreate the traditional, European type city is somehow derived from an appreciation of the fine-grained, compact city that tends to be created by the tight, densely connected networks of pre-car movement. .

The nineteen nineties saw another appraisal of the city. Instead of rejecting sprawl and the periphery, writers like Sudjic and Maspero strove to include the periphery, the edge city, into discourse (Wilson, 1995:5). This approach challenges the idea that the suburb is meaningless; that only a city centre gives a place meaning and asserts an anti-sprawl stance is elitist (Wilson, 1995:6). Part of the justification this is based on the observation that urbanist designers can promote a compact, traditional, walking city while in spite of all their earnest pleas, the sprawl just keeps on happening, regardless of all this focus on the 'good' city form. Sudjic

says that where there is a choice, people very often choose *not* to live in “cramped city centre homes” (1992:309). Does this mean that people actually *want* sprawl despite the best efforts of determinist and neo-traditional designer dictates? We are asked “not to turn our backs on this new form...the backdrop of everyday life” (Sudjic, 1992:297). Is the sprawling city the inevitable space of the present and foreseeable future? Should we therefore give up the seemingly lost cause of trying to make cities ‘good’?

Sudjic argues that to ignore forces of mobility that are creating the modern city is, indeed, futile (Sudjic, 1992:305). But working with complex systems is indeed often futile; when systems are in powerful attractor states, attempts to shift the systems from these attractors will fail many times. Throwing our hands up in despair, thinking that the system is teleological, that it ‘wants’ to be in a particular attractor is not the only response to dealing with complex systems.

So we are never in control of emergent systems, and that fact can become a scary deterrent against adopting complexity theory as a tool for urban design. In the next section, I consider the limits of what can be done in the practice of urban design and consider how we can design with complexity.

6
The law of requisite variety
or,
Designing with complexity

The law of requisite variety

Control can be obtained only if the variety of the controller is at least as great as the variety of the situation to be controlled.

(Skyttner, 2005:100)

People who have observed complex systems have always noticed complexity effects, but it is only since the nineteen eighties and nineties that the properties were both more fully understood and more widely known. How designers can accommodate complexity theory in their practice is a question still very open to experimentation and discussion.

An initial response is for spatial design to focus on 'openness', perhaps characterised by Paola Gregory's discussion of

...architecture [which] opens up lines of flight, lines of deterritorialization that create infinite concatenations: an immense useful plane that can be accessed and travelled in any direction; an open and eccentric system that

closes nothing...through the material - become porous - to allow the flows to move through it.
(Gregory, 2003:30)

The openness here is not an automatically successful tool for responding to complexity; flows in any direction on an immense plain could easily miss each other, fail to interact in dense or diverse ways. Alternatively, opening a previously closed system could have profound effects on order of the system.

A specificity of openness, of how openness is structured, and of how particular systems react once they are opened (or otherwise re-structured through design), must follow the initial understanding of openness.

In this chapter I first look at how Kauffman's ideas of an evolutionary fitness landscape can be interpreted as applying to the system of design. Next I examine precedents from architecture, interior architecture, urban design and landscape design, with a particular focus on designs that alter the structure of interactions within their contextual system.

Design as agent in complex system

Theoretical biologist Stuart Kauffman describes the development of 'technological objects' - things made by people - as using a process of emergent evolution in the environment of culture in the same way as the biological entities evolved in their physical environment (1995:179). As well as technological objects and biological objects, organisations are also capable of an emergent evolution within their respective economic or political environment occupying similar positions in their respective systems, somewhere at the edge of chaos (Kauffman, 1995).

...both biological evolution and technological evolution are processes attempting to optimize systems riddled with conflicting constraints. Organisms, artefacts, and organizations evolve on correlated but rugged landscapes. (Kauffman, 1995:179)

As a type of organization, the city too can be an evolving system, as long it is occupying that edge between complexity and chaos.

The landscape Kauffman refers to is a 'fitness landscape' - a type of phase space where all possible forms of the unit are represented in the x-y plane. The z dimension rises and falls, creating hills and valleys, according to how well each particular variation on form (perhaps more accurately speaking, phase) at that point is adapted to its environment. Evolution constantly probes the fitness landscape by sending out mutations, "feelers",

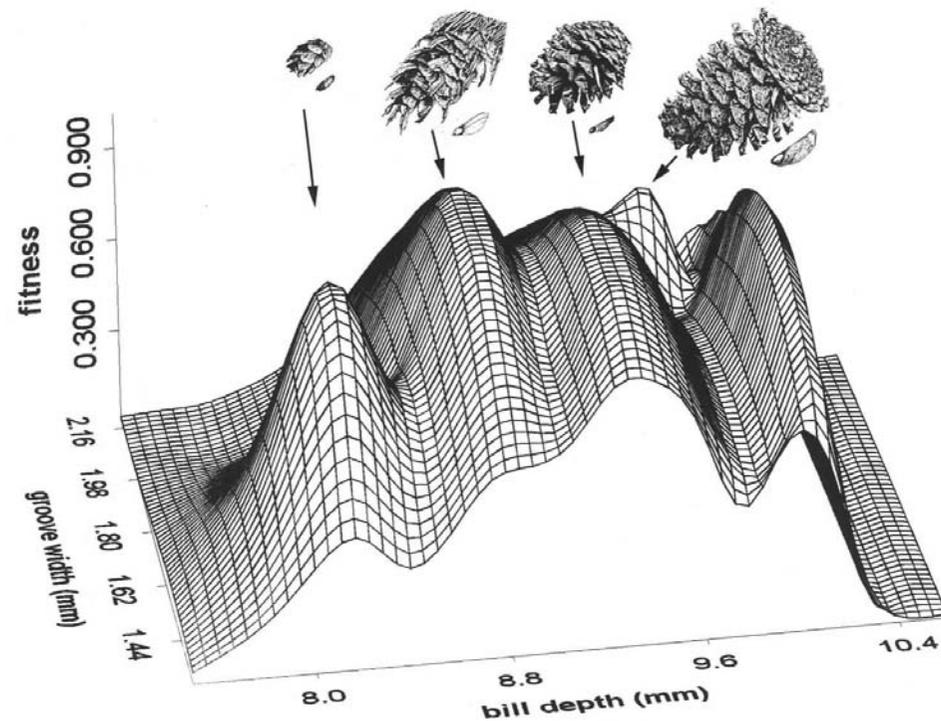


Figure 29 fitness landscape for crossbills and cones, Craig Benkman

to find new peaks. When the new peaks are found, the whole population moves towards these new peaks. (Kauffman,1995:154). The fitness landscape is not a stable or inert place, as the development of other units changes these peaks in the landscape. For example, the evolution of the tin opener increased the fitness peak for the tin can. As improved tin openers evolved, from crude tin shears to ergonomically efficient openers, the fitness of the tin cans for their environment increased; their form did not change but people's ability and willingness to use them did.

For the organism, the artefacts and presumably the cities, "it is constraints that create rugged fitness landscapes." (Kauffman, 1995:192). Kauffman points out that intention is a part of our exploration of the landscape of artefact, missing in biological evolution. I see this intention as part of the work of the designer. The designer is an explorer of the fitness landscape, creating mutations or hybrids of existing artefacts. Through design, we therefore not only 'evolve' the biota, the artefacts of culture, but we move culture itself through to new fitness peaks, to new places in phase space.

One result would be that careful, lengthy observation of the systems we design in, culture and society is very important. According to Kauffman, seeing the overall fitness landscape is impossible. But the purpose of so many of our tools of observation and investigation is to allow us to see the patterns outside our immediate and obvious perceptions, that so many of our tools of all kinds - history, science, literature, art - are ways of sending observational balloons up above the fitness landscape to glimpse some-

thing of the surrounds of our immediate place in phase space.

Theories and generalisations may not be good substitutes for observation; an inherent quality of complex systems is their unpredictability:

...the theory of computation tells us that such a device [a real non-equilibrium computer] might be behaving in such a way that it is *its own shortest description*. The shortest way to predict what this real physic-

physical system will do is just to watch it.... But cells, ecosystems, and economic systems are also real non-equilibrium systems. It is conceivable that these, too, behave in ways that are their own shortest description.

(Kauffman, 1995:22)

Another result of the idea of design continuously evolving in response to feedback would be that designers need to pay close attention to the feedback loops activated by our working process. Money is one feedback device, as is pleasing clients: peer recognition another. Photogra-

phy is often the device for enabling a peer recognition feedback, and it is possible to think of the ways in which disciplines such as architecture and landscape architecture are evolving towards photogenic designs as a result of this. The seeking of feedback through juried competitions, too, plays a part in determining the direction and manner of the evolutionary process.

Meaning is both created and expressed by this system. Design is communication and human communication "...involves a continual coordination of behaviour, and because it involves conceptual thinking and symbolic language it also generates mental images, thoughts, and meaning. Accordingly, we can expect networks of communications to have a dual effect. They will generate, on the one hand, ideas and contexts of meaning, and on the other hand, rules of behaviour or, in the language of social theorists, social structures" (Capra, 2002:83).

Form is not an arrangement of matter forever fixed in a static manner. Form is always subject to the processes of the system in which it is embedded. When we attempt to preserve objects by careful curating, we are forced to isolate them from their surrounding processes. We isolate them from moisture evaporating and condensing, from changes in light, we protect them from insects and chemicals and from the touches of people passing.

Design and change in complex systems

Landscape architecture attempts to embrace the multiple processes in which their designs are embedded. The illusion of creating form without considering process is hardly plausible in contemporary landscape architecture.

Complexity theory gives an understanding of all form as morpho-ecological whereby form is co-created by the processes of their contextual networks. A morpho-ecology is the coupled system of form, agent and process. This close and interactive coupling means that not only is the form stable and fixed, rather, it is changed by the agents and the processes but also the agents and processes are changed by the form. This understanding erases ideas of form as inert, independent and fixed.

With this also comes the understanding that systems can learn, evolve and adapt (Cohen and Stewart, 1994, Capra, 2002, Kauffman, 1995). Processes alter form over time,

the form adapting to the processes, while processes alter over time, adapting in response to the particular forms of their environment. This includes the built form, something Stewart Brand explores in *How buildings learn: what happens after they're built*. (Brand, 1994). This morpho-ecological evolution is a creative act. Novel form is made in this process.

Achim Menges describes morpho-ecologies as the interaction between humans and their environment when linked by a feedback process, resulting in modulations of the whole system. "Emergent organisational effects then facilitate the mutation and migration of human activities" (Hensel, Menges & Weinstock, 2004:81). He sees the relationship between form and humans, or environment and system, as an emergent feedback system – the built form affects the human system, which then affects the built form. Because the form-finding process is driven by a self-organising system, the linked system will evolve "in relation to selected performance criteria." (Hensel, Menges & Weinstock, 2004:93).

Emergent form generation

Important developers of this approach are Menges, Weinstock and Hensel who make up the Emergence and Design Group.

Emergence, they say, requires that we not see buildings as fixed, but rather as "complex energy and

material systems that have a life span, and exist as part of the environment of other buildings, and as an iteration of a long series that proceeds by evolutionary development towards an intelligent ecosystem" (2004:7).

They use agent-based modelling to find efficiencies through the evolutionary processes associated with complex systems.

The resulting forms are compelling - with an organic yet alien beauty. If aliens are in fact evolving on other planets, they would be subject

to the same processes of complexity as life on Earth, but experience different feedback devices.

Hensel defines traditional form-finding as a one-way, linear process, with a focus on feedback to simple structural requirements and outlines the feedback he is concerned with: first, forces on the material of form; second, "the dynamic relation between material arrangement and human subject" and third "interactions between human subject and environment that assert indirect influence on material arrangements" (2004:29). I find it relevant that he appears to position the human as the 'subject' of the built environment. In one section of the book, he describes his 'post-twin towers' project:

This design was a parasitic envelope over a twin tower base, required to evolve towards load bearing, volume, circulation, and having a series of interstitial spaces. However, a weakness to this approach is finding a way of interacting with the human subject.

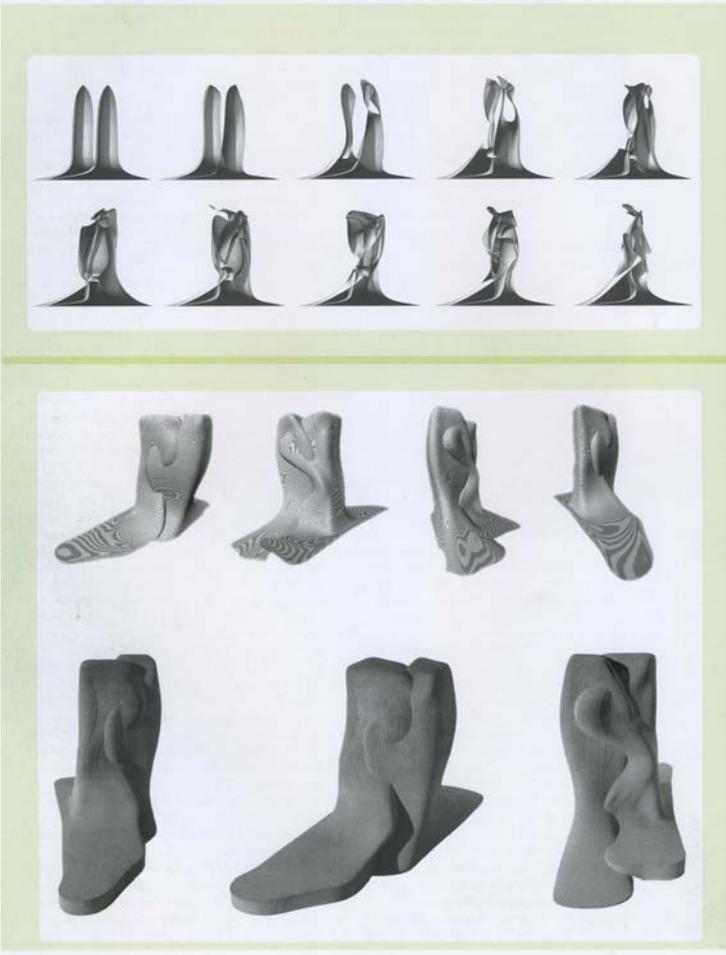


Figure 30 Hensel's World Trade Centre project page 30

For example, the depth of the final form means there are spaces with no light penetration. Hensel champions a differentially inhabited interior and says “[r]ainforests and the oceans can serve as organisational models, where even in the lowest and darkest regions micro-ecologies flourish” (2004:33), presumably meaning the inhabitants will have to adapt to the gloomy inner regions of the structure rather than the structure adapting to the preferences of the human subjects, and provoking images of the evolution of pale skinned, large eyed inhabitants, able to be lured from the deep recesses by the phosphorescent glow of computer screens. Rules of efficient inhabitability are presumably very debatable and not easy to program into the software. At the time Hensel wrote this, he says they are now close to having being able to combine “geometric, structural, material, spatial and habitational characteristics” (2004:31).

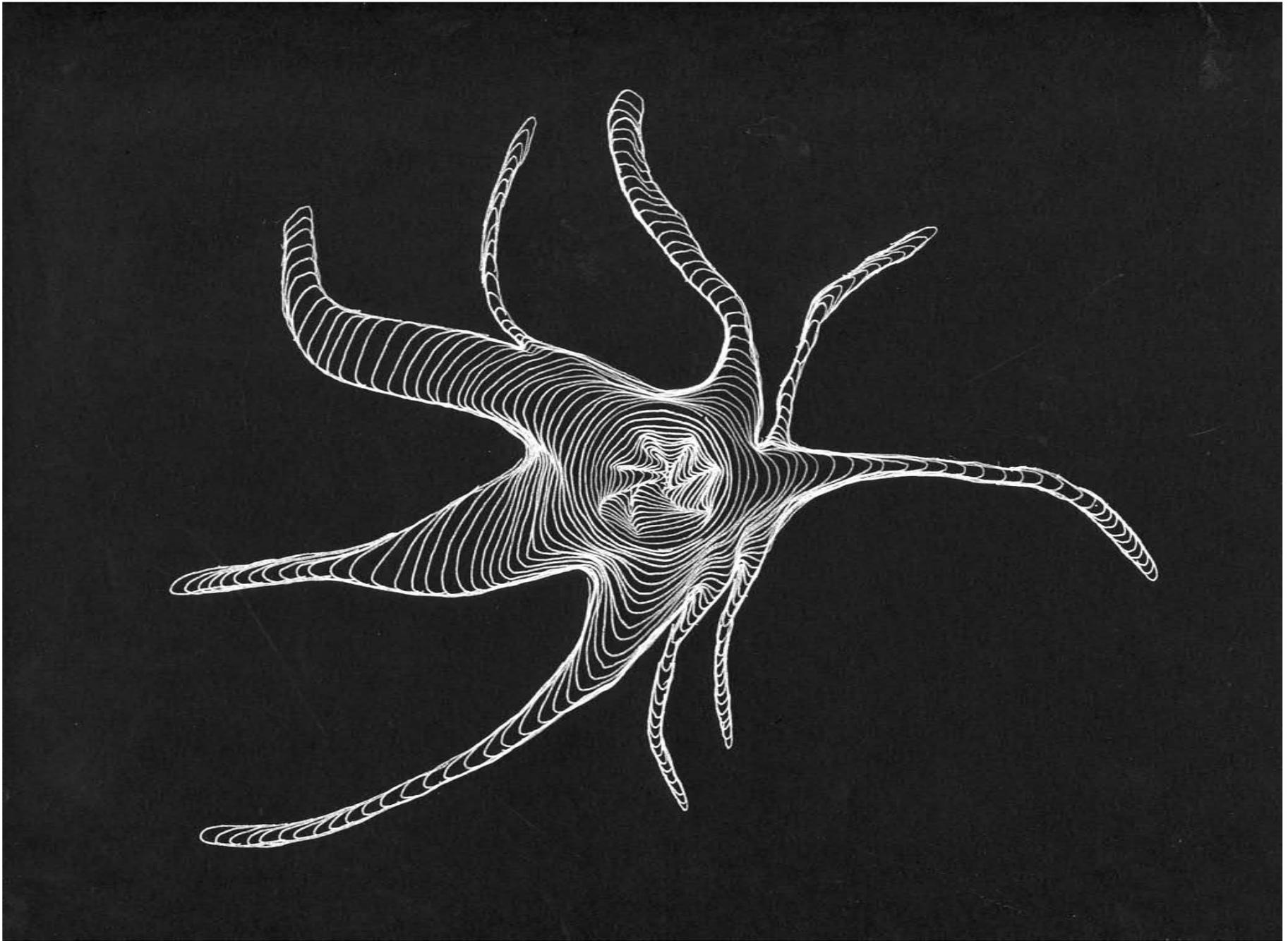
These socially unresponsive structures are not yet the full response to *all* the ideas of emergence and complexity theory. Brian Hatton writes in the introduction to *Ecstacy* “...the phenomenology of 'emergence' has to be found in social narratives and real lives rather than landforms, that complexity is generated architecturally more by intersubjective human spontaneity than by hypersurface geometry” (cited in Coates, 2003:30). To treat the built form as having *both* the human as a subject and the built form as subject *to* the human inhabitant would be an aim for habitable design that encompasses complexity theory.

Layering, as a design tool, works with interactions that are unforeseeable and unpredictable. This can encourage the emergence of new forms

or programmes at the moments of interaction between layers (Gregory, 2003:17). Gregory emphasises that layering allows users to create their own connections and through this, determine the eventual organisation (2003:30).

Without consideration of how layered designs have been inhabited, what types of interactions they have initiated/suppressed and how the larger systems have responded to these changes, it is hard to assess how effective layering is as a specific tool for

Figure 31 Emergent form



complex systems.

Recombinant design, too, can be understood as a design tool that encourages emergent designs. Recombinant design can accelerate design evolution, the exploration of new peaks in the fitness landscape of design in the same way that haploid sex accelerated the evolution of species. Various tools of emergent form generation are exciting ways to evolve design. They are not irrelevant to broad questions of design and complexity, but as I have a focus on urban and landscape systems, I look with particular interest at designs that specifically alter interactions through spatial interventions.

Spatial design and interaction

If innovation is a social process that involves complex interactions among individuals...then fostering these complex interactions...brings so-called soft aspects of workplace design to the fore...We need to interact in them, not pose in them. (Thackara, 2005:99)

The structure of office space design can be used to support the structure of the company's organisation by ordering interactions in space. In *The organizational complex*, Martin describes architecture "as a conduit for organizational patterns passing through the networks of communication that constitute the system's infrastructure" (2003:4). He sees the work of architecture as actively integrating "spaces and subjects into naturalized organi-

organizations" (2003:4).

A hierarchical, tree- type organisational structure adapts easily to an office layout based on the tree.

An organisation structured in a more circular way is supported by a circular spatial layout.

The modularity and flexibility of the 'organisational complex' was simultaneously created by, and imaged by, the steel-framed gridded office structures that housed them (Martin, 2003:5).

Moving one company into another company's office will challenge the structure of the organisation – perhaps until either the space is adapted by the organisation or the organisation's structure is adapted by the space. Boundaries and openings allow or encourage interactions between some parts of a system and limit interactions between others. Module-creating boundaries in complex systems can function as "walls of constancy, through which no signal can pass, emerge which carve the system up into non-interesting modules" (Richardson, 2004b:80). It is not only the situating of boundaries that shape interactions. Different patterns of social behaviour operate in different spaces.

Simple size or density of population is not the key predictor of complexity. Increasing the density of agents within a space may lead to complexity, but in fact it is the density of *interactions* that generates complexity. For example, how housing is densified, the accesses and group spaces changes the way people interact. Blake is scathing of the way

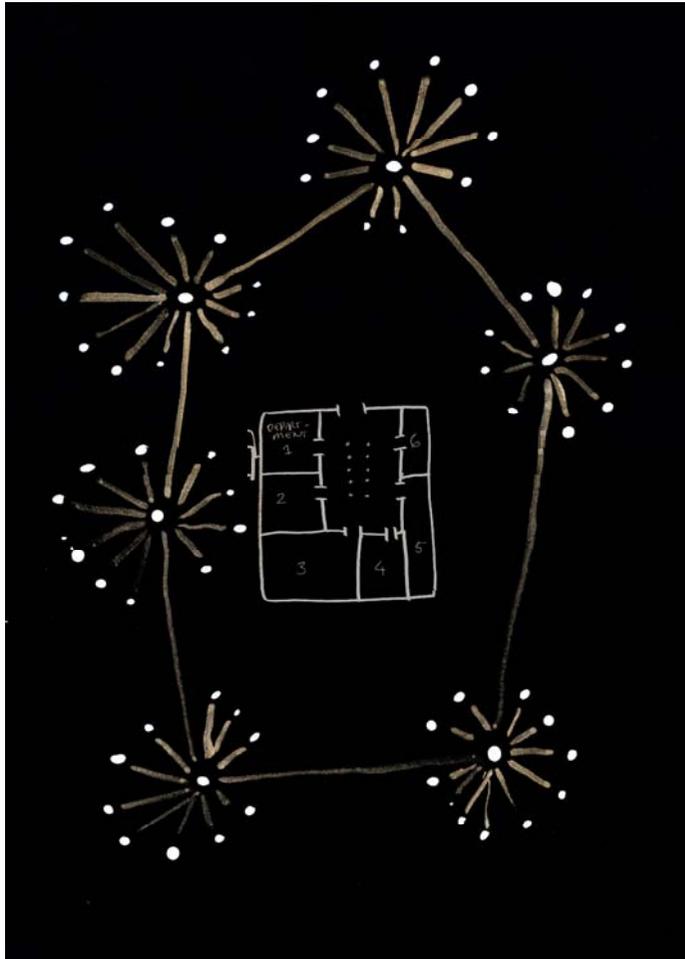


Figure 32 decentralised organisation diagram is suited to a decentralised layout

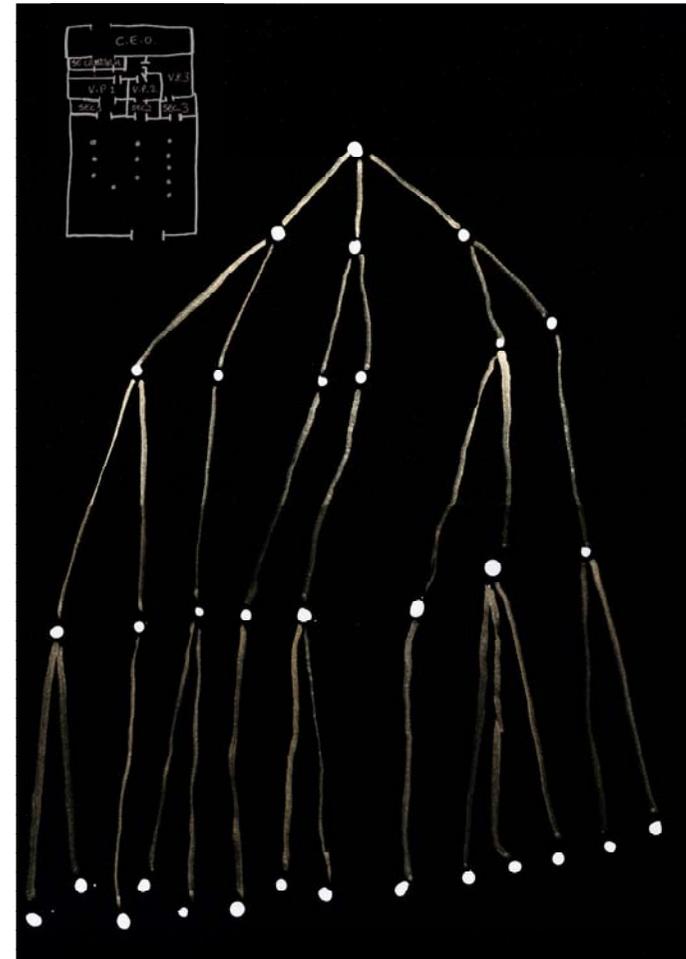


Figure 33 hierarchical organisation structure is supported by hierarchical space

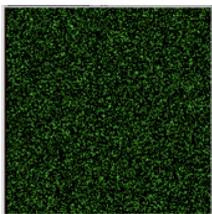
high-rise buildings destroy interaction via the lift (Blake, 1974:70). Not only does the lift neatly modularise people into tiny clusters, but the way people interact in a lift is very different from the way they interact on a street, with the strict 'lift code' of staring straight ahead at the doors rather different from a 'street code' of behaviour, where the glance or gaze is not disallowed.

Diversity of interactions or agents is another creator of complexity (Kauffman, 1995:69). Creating interactions across social boundaries is therefore a complexity design tool.

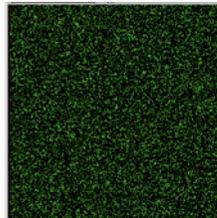
Figure 34 NetLogo model of density in forest fires. Treedensity increases by small amounts but emergent behaviour, in this case fire, can be affected dramatically

An example of a non-linear threshold of density

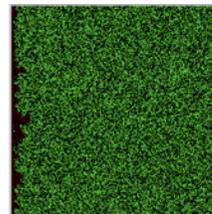
At 25 % tree density, 0.6% of trees are burnt



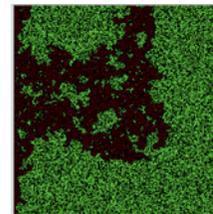
At 34% tree density, 0.9% of the trees are burnt



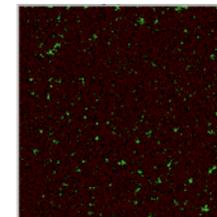
At 52% tree density, 2.5% of trees are burnt



At 58% tree density, 30.5% of trees are burnt



At 61% tree density, 80.1% of trees are burnt



Form without process

Changing form can alter the process. This can act either catalytically or the alteration can be one of a large number of interactions within the system. Formal design is thus capable of tipping the system into different attractor states.

Similarly, altering or designing the processes has potential to alter the form, in this way acting as a design agent.

Paying attention to form but ignoring, or misunderstanding, process has the potential to lead to alteration of the process of interaction. In extreme cases, this can lead to a collapse of the self-organising behaviour that keeps the system at a high level of order.

And then, without this high level of order, the system is unable to maintain the form that was intended in the design action.

Ecosystems In design for ecosystems, there is often little thought given to the aesthetic or formal properties of the designs. The focus is entirely on arranging spaces so that sufficient interactions can occur and minimising fragmentation. The resulting functioning, flourishing ecosystem is the provider of our aesthetic delight

as much as the formal qualities of the design.

Ecological design works to improve or maintain an ecosystem. The ecosystem is understood to have been highly connected before settlement and fragmented by the settlement process (Linehan et al., 1995:180), and that the fragmentation of habitat presents an extremely serious threat to biodiversity (Collinge, 1996:59). Settlement or development means changing the structure from a matrix structure of ecological connec-

tions to one consisting of nodes, corridors and patches (Ahern, 1991). Broadly, goals for ecosystem design are to foster: density, diversity, interaction and connectivity, all eventually leading to that fully functioning complex web of interactions, an ecosystem. In other words, the focus is on ensuring the networks interconnect as much as possible rather than on a consideration of form – and where form is considered, it is in terms of edge to volume ratios and their impact on interactions (Collinge, 1996) . The connection is as important as the size or shape of the habitat and design focuses on assessing the wildlife and their habitats, followed by node analysis, connectivity analysis and network generation (Linehan et al., 1995:181).

The design of space for ecologies has had to take complexity into account for a fairly long time. Lovelock's Gaia hypothesis, first published in the 1970s is one of complexity theory's early discipline-creating models.

Ecological design can aim ecologies toward specific attractor states, i.e. a climax

forest rather than gorse scrub. In order to do this, particular interactions are privileged, or cosseted (breeding programmes for some species) while other interactions are harmful to the desired attractor state and reduced or eliminated (the interactions between possums and rata trees are minimised by killing possums).

Once the desired networks have reached a critical density then the morpho-ecological qualities take over. A climax forest will perpetuate itself and possibly spread, take over outside its boundaries.

Predator proof barriers surround the Karori reserve in order to interrupt the ecological network where introduced species feed on native flora and fauna, which have not evolved defences against the predators.

The network was altered by both fences and by the introduction of native species. As the ecological network within the reserve has grown stronger, this new, stronger network has started to expand outside the physical boundaries of the design, of the reserve. Apparently there are many more birds in central Wellington now, and this has been attributed to the reserve.

"..Stuart Nicholson continues to see kaka in Brooklyn at dawn and dusk, presumably birds that are

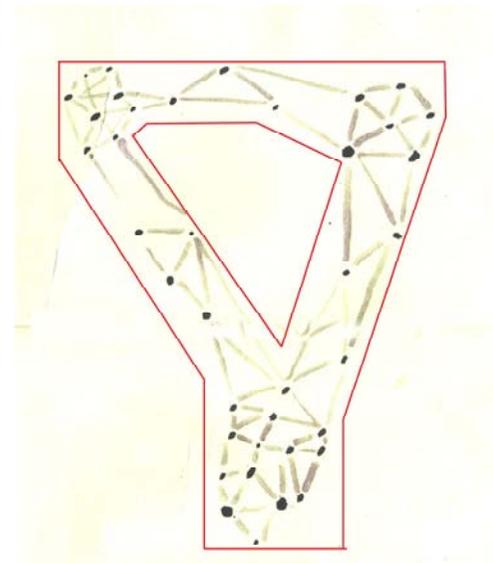
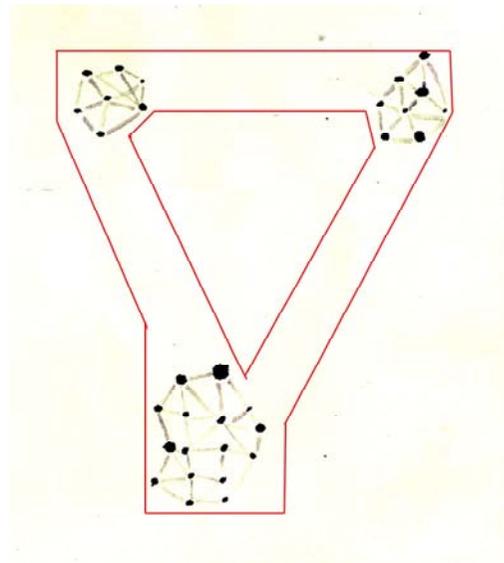
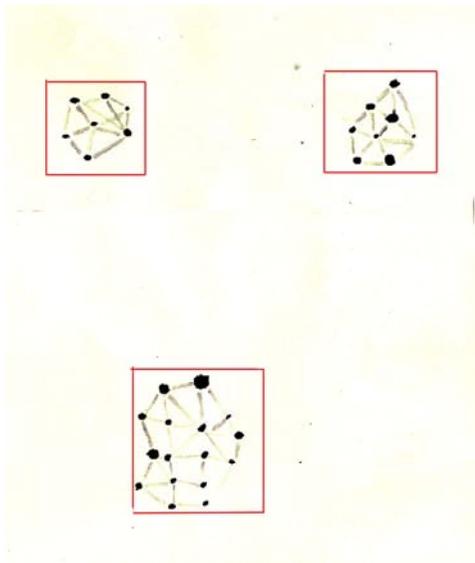
Figure 35
p r e d a t o r
p r o o f f e n c e
a t K a r o r i



ranging out of the Karori Wildlife Sanctuary" (*Ornithological society of New Zealand Wellington Regional newsletter, 2006*).

This has potential to alter the wider landscape of Wellington as these birds fertilise the ground and spread seeds of the native trees that they feed on in the reserve. The network that was altered by the design of the reserve will start altering the landscape beyond the physical boundaries of the fence, changing the landscape in a way that will suit and support this altered network. A feedback loop is established – the landscape

is altered to support a native-species network and the network then alters the landscape to further strengthen the network, which then further alters the physical world....



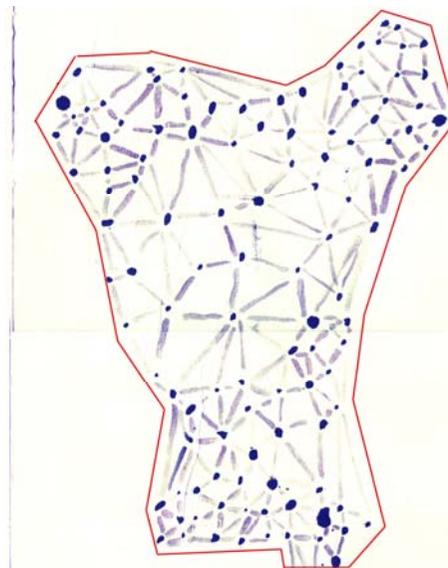
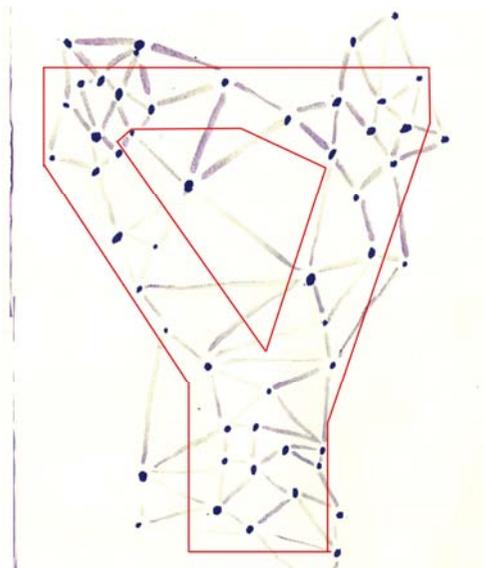


Figure 36 Morpho-ecological system

First, the disconnected clusters are connected

A density and diversity of interactions is allowed by the form change that connects

Interactions create a strong ecology, strong enough to start manipulating the form in turn

Cities

Cities and ecologies are metaphors for each other; both structured from multiple networks, both multiply interconnected. This similarity in structures means similarities in behaviours. The linking of food networks, predator interactions, parasitic, symbiotic and spatial connectivity work in both systems. Both display the counter-intuitive effects of complexity theory, the folded phase spaces and phase transitions. Neither can be understood as form only; processes must be

traced to begin to know an ecology or a city.

As well as working to increase density of people, work to increase the density of interactions, and the richness of interactions. Instead of trying to 'stream' pedestrians so flow quickly and smoothly through the city, look for a little 'roughness' in the flow.

The idea of 'noise' in an information stream implies that interactions should not be overly random and meaningless.

On mess: "...a whole new aesthetic must be accepted, not so much by designers (who could easily be entranced by mess), but by the public and the various public institutions...The notion of control is fundamental to their demonstrable activity in the landscape." (Raxworthy, 2007a:108). The best efficiencies of complex systems seem to be found at the edge of chaos (Kauffman, 1995).

...complex systems must be understood from the bottom-up and that prior reductionist strategies simply fail to grasp the way such systems work. Process rather than product, function rather than form, time rather than space are all important... (Batty et al., 2006:71)

Critique of complexity

While this thesis demonstrates the usefulness of using complexity theory as a basis for analysing and acting on urban conditions, there are undoubtedly also issues to be confronted in this approach. Most importantly, as a comparatively new area of investigation, the debate on this subject is still being formulated. However, debate on the advantages of using Gaia theory as a basis for analysing the planet's ecology has been well advanced in the last thirty years and for this reason I propose to equate a critique of

Gaia with a critique of the complex city and as part of this paralleling operation I will refer to the complex city as 'civitas'.

Both Gaia theory and complexity theory have 'strengths' of application: there is a weak Gaia and a weak complexity, strong Gaia and strong complexity. In weak Gaia the environment influences an organism and an organism influences the environment, but saying this is saying little more than the obvious, and the conclusions that can be extracted from applying weak Gaia to an investigation turn out to be not much more than common sense.

In strong Gaia theory, the emergent patterns of the planetary system not only appear to be purposeful, but are regarded as purposeful. Discussing the purpose the planet, or the natural systems, as God-like is well outside the scope of environmental science and so does not form part of the intellectual debate.

The most fruitful area for enquiry lies between these two extremes, where emergent behaviour, the behaviour at a meta level, is studied but not attributed a purpose.

A weak civitas would therefore hold the position that the environment of the city influences individuals and individuals influence the environment of the city. in a similar way to weak Gaia, this would yield few results beyond common sense. A strong civitas might say that a city has its own purpose and is completely beyond the control of the inhabitants.

The positions Dejan Sudjic takes in *The 100 mile city* (Sudjic, 1992) and Rem Koolhaas in *Whatever happened to urbanism?* (Koolhaas, 1995) seem to be the equivalent of a strong civitas: the city develops in ways of its own, ways often in complete contradiction and contrary to the intentions of urban design professionals.

Complexity based analyses of social patterns as emergent behaviour based *feel* wrong. Of course, it is entirely possible they are wrong – I will discuss the limitations to modelling below. But they feel wrong because complexity equates the behaviour of bits, neurons and ants with the same importance as people, as human beings. This lack of emphasis on the status of people and their importance to systems is made explicit in the key concepts of the Gaia hypothesis:

(3) Humans have no special place or role in Gaia...

(8) [biomineralization] in some ways
blurs the distinctions between living and
non-living things

Scofield, 2004:151

There is no doubt that little special value is
placed on humanity in this theory; even the min-
eral organisation becomes elevated in importance
while humans are demoted, in our own eyes at
least. These concepts do not translate completely
to the city as unlike the biosphere the city is built

with intent by people. People therefore *do* have a special role in civitas. A parallel appli-
cation of biomineralization to civitas (the city mineralization process referred to by De
Landa) would be that the city is a blurred living/non-living entity. This is an under-
standing which elevates the status of the city from inanimate built form and so alters the
comparative status of the human and their built environment.

The differences between complexity and reductionism arise from the multiple un-
derstandings acknowledged in complexity theory, as well as the importance of bottom-
up processes rather than top-down implementation, values that easily find social and
political favour. In fact, humility seems to be a common response in complexicists, who
are required to always be aware their systems are unknowable and unpredictable. This is
exemplified by Stuart Koffman:

If one can never know of the next footstep is the one that will unleash the landslide of the century, then it pays to tread carefully.

In such a poised world, we must give up on the pretense of long-term prediction. We cannot know the true consequences of our own best actions. All we players can do is be locally wise, not globally wise.

(Kauffman, 1995:29)

Despite the newness of complexity theory, many of the results of complexity are not new and do not overturn all previous knowledge. Many of the principles or results have been discussed for centuries. Examples of this are Aristotle's 'the whole is greater than the sum of its parts' (wholism) and the Bible with 'the rich get richer and the poor get poorer' (power laws). Part of the tactics of this research has been to fit writers (in particular de Certeau) into a framework of complexity and find a close match.

One of the appeals of using complexity theory is

that it does not seek to eliminate any one form of knowing the world, but tends to accept existing epistemologies as special cases. In contrast to a post modernist approach, which can appear to denigrate scientific thought, complexity instead sees a reductionist scientific investigation as rigorous and valuable when the system studied is simple and yet, when complex, is liable to produce the dis-information that is so rightly decried by postmodernists when the system studied is complex.

Another one of the limitations of ap-

applying complexity to the city is the limitations of the applicability of results derived from the use of modelled results to the real world (Schneider et al., 1991: 37). This is the problem climate change prediction has. A very large amount of climate change is studied through the use of computer models. This lays it open to the (correct) criticism that modelling cannot truly prove that climate change exists in the real world. The same is true of all complexity arguments; they are un-provable in the real world. Even the simplest of complexity models, Per Bak's sandpiles, does not completely model the actual behaviour of real sand. Models of complex systems involving human behaviour are, of course, even less likely to be completely described by computer models.

From a methodological point of view, model experiments are only in some respects similar to real experiments. The main difference from real experiments is, of course, that the scientist is interacting with a representation of a material object and not directly with the object itself. In the evaluation of model results, therefore, the reliability of the model (i.e. the scientific quality of the representation of the object of study) is always at issue.

(Schneider et al., 1991:37)

Despite these problems, many results from complexity modelling show such closeness to observed behaviour that the study of complexity demands attention. It is through the continual work of attempting to find correspondence between the observed world with the predicted world that that theoretical positions find validity.

Summary

Working without a knowledge of, and a method suitable for, complex systems can mean that form and process in a design work against each other. Working with it can mean that form and process work together to amplify positive effects. Because of the morphological effects, this process will carry on 'designing' without the direct intervention of the designer.

Complexity theory and design interact on many levels. Design is created by an evolutionary process within the environment of culture and

this materialisation of culture in turn creates the environment for culture to evolve in.

Evolution of form can be forced using agent based modelling. Moreover, careful attention to designing with processes, the iterations and interactions and so work with, rather than against, the effects of complexity.

Design in this view is not an end point, something that can be completed. Design instead works like a seed, a potential start point for the transfiguring of space. If form and process are one (complex) unitary system, then the adjusting or changing of form is only a partial response to spatial design. A complete spatial design addresses an adjusting or change (or of course a conscious decision to retain) the processes that exist in that space. Time is an important factor in this, as processes unfold and emergence occurs over time. Does this mean spatial design is not 'finished' at any particular point? The unfolding emergence of the space is under continual evolution – in a metaphorical sense space

is an organism that is designing, making itself, so ideally the designer (co-creator) should be involved through time, and with the process.

Determinism is also addressed in this project. I believe that determinist design has been seen as a failure because determinist design in the past has been aggressively reductionist in its approach. Dealing with almost any system involving living things is complex. Making reductionism an incomplete way of working with the system. Complexity theory implies that our actions have agency, and sometimes catalytic agency, but we cannot have global knowledge of the whole system. Taking a theoretical stance that claims to design in a non-determinist way does not absolve one of actual determinist effect in a complex system. Kauffman puts it that as we cannot be globally wise, we must attempt to be locally wise and brings up the image of Per Bak's sandpiles, always on the edge of chaos, where moving one grain of sand can start an avalanche and we never know which grain of sand that will be. We still have to move – but it is a good idea to move awfully carefully in such a system! (Kauffman,1995:29).

Thackara gives these design guides:

From blueprint and plan to sense and respond

- From high concept to deep context
- From top-down to edge-seeding effects
- From blank sheets of paper to smart recombination

- From science fiction to social fiction
- From designing for people to designing with us
- From design as a project to design as a service (Thackara, 2005, 213).

In conclusion, design, through constructing forms that allow/disallow interactions, inescapably constructs the processes working in that space. Constructing the processes influences the emergent/self-organising behaviour. The process can then go on to influence the way 'mineralisation' occurs, in effect designing itself. Ways of working with this complexity would likely centre on Green et al's trio: change agents, change structure or change interaction

Perhaps modernism works in artefacts that have linear functions rather than non-linear functions. There is still beauty in minimalism, but we cannot seek it in complex systems.

Seek out the feedback devices in the system. Modernism had a tendency to feedback to the machine – not only did a machine aesthetic and functioning inspire modernist design, but efficiency in manufacturing added another machinic feedback to the design system.

Our intuitions about the requirements for order have, I contend, been wrong for millennia. We do not need careful construction; we do not require crafting. We require only that extremely complex webs of interacting elements are sparsely coupled.

(Kauffman, 1995:84)

This is the way in which the design of an infrastructure of interaction can contribute to this ordering

of interactions in the city. Designing to allow for sparsely coupled interactions is different design aim from the idea of careful construction of, or crafting of, the city. Lucien Kroll says

When everything is designed, it too easily becomes a sort of concentration camp...we should instead try to organise a climate where a kind of friendly organisation is able to emerge spontaneously. We know there are naughty architectures and we should avoid them...We should speak about and make gentle architectures. I think the definition of a good architecture is one where people are friendly because of the architecture. Perhaps this is fuzzy, but it means something..." (2005:183)

7

A redundancy of resources

or,

**The interactions and processes of
movement**

Redundancy of resources principle

Maintenance of stability under conditions of disturbance requires redundancy of critical resources (Skyttner, 2005:100).

Within the emergent modular and hierarchical structures of complex systems--its sub-systems and levels--redundancy in feedback also provides a means for a system to maintain itself in the face of external forces. In a sufficiently well-connected module there are many routes from one node to any other node. If the signal between one node and another is blocked by the disruption of an intermediary node, then there may exist the opportunity for the signal to be transmitted via another route ...

(Richardson, 2004b:81)

This chapter looks at the processes and experiences of moving, rather than the form and ordering of the street space of chapters three and four. The aim is to examine the type and patterns of interactions created by these two processes.

The chapter continues the discussion of the ways in which the infrastructure of interaction has been subsumed by the infrastructure of movement. As in the case of deck access housing in Hulme, the subtle interactions and their structuring can have a large impact on social patterns, here looking at the subtle exchanges of information made while driving or walking.

No one can know in advance exactly which interactions or pieces of information are going to be critical and productive and which will be redundant. Tracing flows of information through social networks becomes an almost myth-creating experience. It is not luck that is driving this serendipity machine; it is a complex network of information. Curiously, certain types and orderings of networks are more efficient at creating serendipity than others.

One of the characteristics of complex serendipity machines is a redundancy of resources.

Large amounts of information flow through the network of our lives, a redundancy of information that mostly passes us by. It is only in hindsight, when we highlight the path the information took to reach us, do we marvel at the non-ordered path it made. For this to happen, we need many redundant iterations.

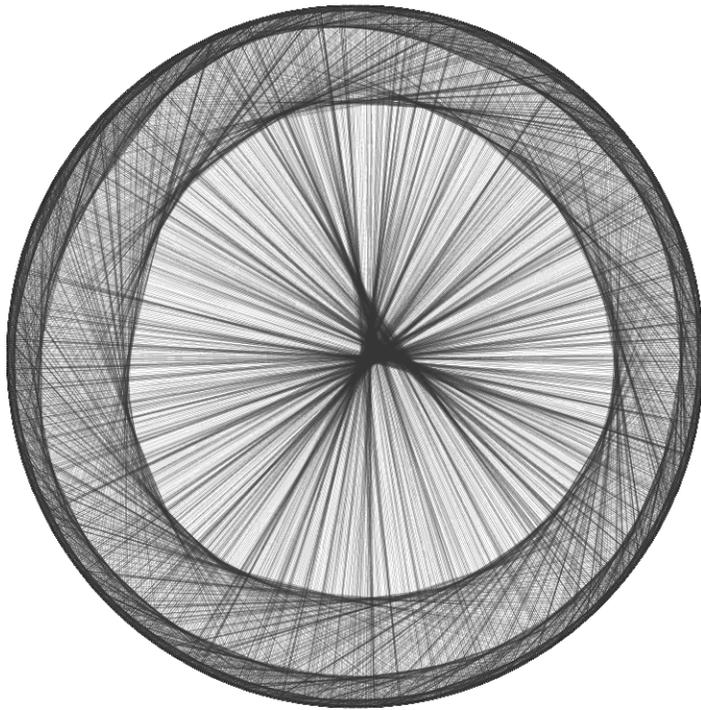


Figure 37 Ordered network

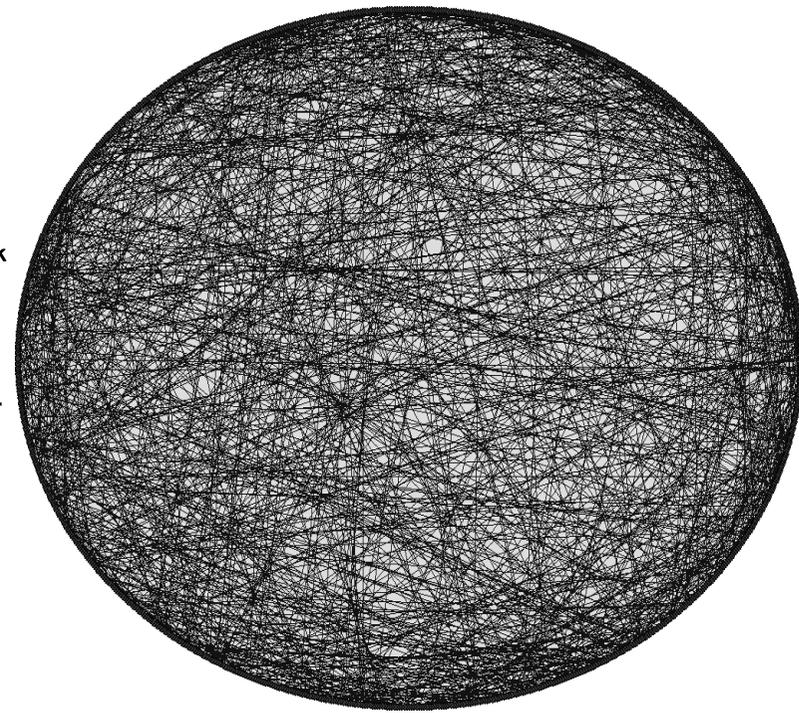
The way the network is ordered or structured also affects the patterns of information flow. Information seems to flow fastest and most efficiently through small world networks, much more so than through highly ordered or very random networks (Strogatz, 2003).

The convoluted hierarchies of complex systems also necessitate examining the system on different scales. Looking at the experience of the body, the reactions and motivations of the driver or the walker on an intimate scale is as important

to understanding the city as the built form is.

The city is composed of, and created by, networks of people moving through space. At the same time, we are creating ourselves for "[t]he same neural and cognitive mechanisms that allow us to perceive and move around also create our conceptual structures and modes of reason" (Lakoff & Johnson cited in Capra, 2002:61). The mode of movement – walking, by scooter, bus, car, taxi, wheelchair, bicycle, ferry, or train – determines the structure of the network. These transportation networks can be highly ordered, semi-ordered, highly connected spatially or with low connectivity, highly connected socially or with low connectivity and so on. A train, for example, will have low spatial connectivity, connecting only at the stations, but a higher social connectivity than a car with a single driver. Or the driver can experience a tightly clustered connectivity in the car, carrying and communicating with family members. Hitch-hiking introduces extreme ran-

Figure 38 random network



domisation to the car's social connectivity. The social connectivity on a train, too, can vary. Crowded trains or buses with many stops seem to encourage codes of social distance (rigorously avoiding eye contact while your body is pressed close to another's), while trains that go fairly directly from one neighbourhood without stopping on the way seem more likely to intensify the social connections, with train discussions originating from neighbourhood issues and evolving into friendships.

Which mode of transport we use brings forth in us a particular way of engaging with the world. The constant iteration of this mode of engagement works in turn to create our understanding of the world and who we are. Sociologist John Urry says, "...it is in these mobilities that social life and cultural identity are recursively formed and reformed." (Urry, 2000:49). It is where our comings and goings "lie thickest on the ground" that we construct everyday life (Amin, 2002:94).

Walking

Walking creates a network of interactions between people on the street. All space is connected. These connections can only be enacted and experienced through our movement, making experienced space different from this theoretically totally connected space. This abstract space is the geometric, panoptic space de Certeau describes in *Walking in the City* (1984).

Walking acknowledges the city as a

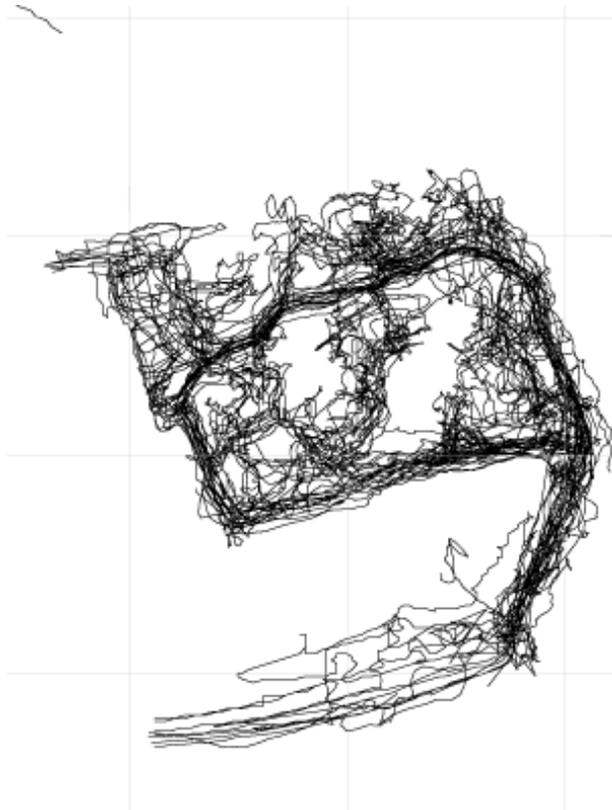


Figure 39 GPS drawing of a walk and a drive

topographic field. All points on the manifold are connected to each other through walking. There are boundaries and barriers of course – walls, doors security guards and dangerous roads, but nearly the entire ground surface of the city can be traversed by walking.

Walking is one of these networks simultaneously acting as a tracing and a connector, a tie between the places of the city, a writing on the ground of the city that ties it together (Careri, 2002).

Walking is the most fluid mode of transport. Within the more limited distance that can be covered, walking encourages movement through the interior and exterior equally well, through

narrow lanes and over large roads. Walking also works to connect the many other networks of the city in a fine-grained, intimate way: One can move between one's apartment, past a street performance, to café and to a business meeting. This process connects and activates networks of kinship, story telling, social interaction and financial networks. Walking is also the connector between other transport networks. One walks between car and office, walks to the bus or train stop. Walking allows slippage between and across boundaries.

Walking through the city happens in a public and largely uncontrolled space. Exactly who we will encounter is unknowable and unexpected. Other people on the street are part of a clustered network made up of those living or working in the same neighbourhood as us, people whose children go the same school as ours, people we went to school with, business colleagues, staff

from shops we frequent. Walking in the street makes one part of a less clustered network too, made up of the people who are tourists, street people, skateboarders whizzing past, people going to a conference, people trying out a new restaurant (Jacobs, 1961, Johnson, 2001).

This network consisting of both clustered and random connections makes walking a *small world* network (as defined by Strogatz and Watts), the same network structure of (amongst many other systems) the brain and the internet

(Strogatz 2003). Walking activates this small world network renewing acquaintances and, through repeated meetings creating acquaintances from strangers. This is interesting in terms of a difference between Wellington and Auckland as cities. While Auckland has a large population, a geographic network with many links, I believe the compactness of Wellington gives a higher degree of meetingness, and a comparatively urban experience despite the small population.

The paths that correspond in this intertwining, unrecognized poems in which each body is an element signed by many others...
(de Certeau, 1984:93)

Figure 40

Meetingness:

mirroring



What follows is an elaborated list of things that bring the city alive, having emergent effects on how we walk, what we experience and how we, through our movements, contribute to the city.

The fleeting encounters made when walking can seem insignificant in themselves. It is the multitude of many encounters by many people that makes for the potential of city-wide knowledge (Johnson, 2001:91). This is a redundancy of resources, an opportunity for signals to be transmitted through many, many routes. Not only do we receive signals of information from the bodies of others, and the city, but we are conscious that we are transmitting, on display. As we are "... using the naked senses to receive embodied messages from others, the individual also makes himself available as a source of embodied information for them...each giver is himself a receiver, and each receiver a giver" (Goffman, 1963:83). This is one way in which the agent walking has a different nature from the agent driving. This knowledge of exposure, of making yourself public, is different from that of the driver.

A first level of encounter is a firing of the mirror neurons. It seems that seeing the body of another person, apparently for as briefly as five seconds only, acti-

vates 'mirror' neurons in the brain. When these mirror neurons are active, the viewer's body models the viewed body, in a sense, taking on their pose internally, into the observer's own motor and emotional responses,, and through this taking on of the other's body, one understands the feelings of the other (Oberman and Ramachandran, 2007:310). This implies that after a walk encountering a number of people, we come to know the mood of the city intimately, through our own bodies.

Figure 41

**Meetingness: the
fashion gaze**



During the minimal interaction made while walking, people pick up numerous cultural clues. Ideas about fashion, for example, are readily transmitted on the street. In Paris, “[t]he latest discoveries are telegraphed on the street and the air is charged with the exchange of fashion information” (Brubach, 1999:120).

The ‘street’ can be the acknowledged destination for the information of who you are contained in clothes. Quick looks flick over outfits, from head to toe. This information is more than trend information, although that, too, is communicated on the street. When I moved away from twin set-wearing Christchurch, I felt quite strongly that Wellington was a very different city, a city of many possibilities as I watched the multiply pierced and tattooed people walking. Designers will investigate street fashion, entering into and amplifying the conversation.

More involved interaction occurs when people stop to talk to each other, and even short conversations are perhaps of more significance to the social and business character/success of a city than they might seem. Granovetter writes in *The strength of weak ties* that, of the people who found employment through a personal contact, 83 per cent of the contacts were only acquaintances rather than friends (1973). Applied to the idea of walked network, this could be the kind of casual contact with an acquaintance meet on the street, creating a business network. Again, exactly which minor interactions are relevant are unknown in a complex system. It is easy to discount these micro-knowledges when there are so many seemingly important big-level things to know about the world. Of course, we also

meet people we have close, strong ties to while walking. We meet cousins we haven’t seen for years, or ex-lovers or school mates, creating meetingness in a social network.

Encounters with drivers are mediated by the car. What is noticed is the machine first and the person only sometimes, “...for the non-car user roads are simply full of moving, dangerous iron cages. There is no reciprocity of the eye and no look is returned from ‘the ghost in the machine’. communities of people become anonymized flows of faceless ghostly ma-

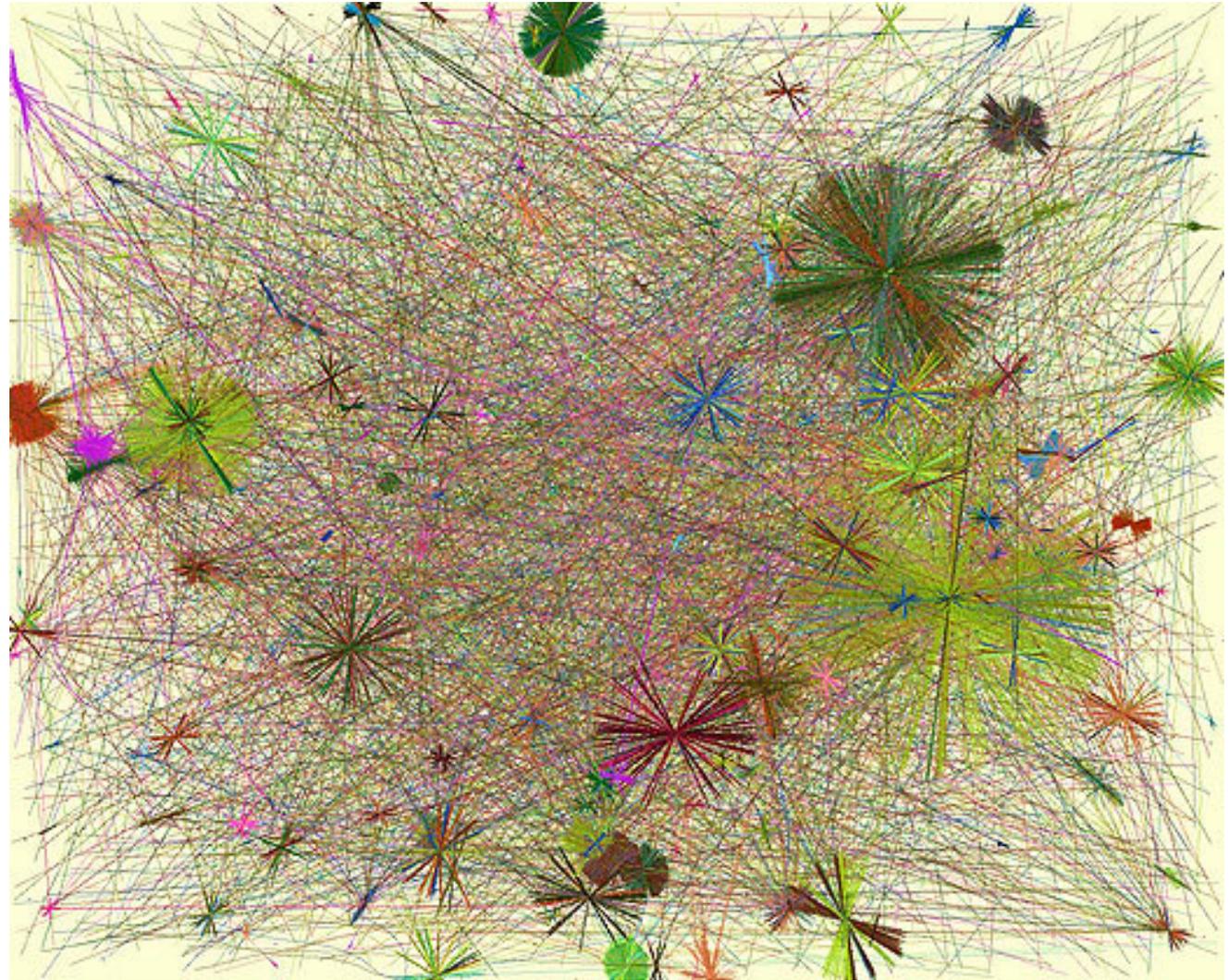


Figure 42 Microfashion network, Butan Arikan & Ben Elton

chines" (Urry, 2004:30).

Information about where you are in place, time and the social environment is supplied in fine grain and detail while walking. Information that does not make the mainstream media, the fringe performances and graffitied politics are known from city doorways and lampposts. These flecks of information collected when walking are like grain collected from gleaning, sparsely distributed in space and time rather than the wholesale downloading of information from other sources, harvesting.

Sound informs our walking. Snatches of conversation overheard can in themselves be illuminating. I was walking behind a conversa-

tion about a wonderful gadget, so then I knew what to get my partner for his birthday, or the number of times the same thing is heard over and over tells us the subject of the conversation is not an anomaly but a trend.

A sense of place is communicated through sound: Sophie Arquette an audio artist, describes ways in which sound informs her of place, creating what she calls a tactile and ephemeral aural space: Heels sharply reflected off glass buildings create the sounds of a banking district, while layers of voiced transactions and calls mark the sound of a street market (Arquette, 2004:162). Sound becomes evidence of human inhabitation and presence.

Space can be claimed by sound, through jukeboxes or mobile phone tones. Music can claim territories within the city (Arquette, 2004). Claims and counterclaims are made with sound. Barry Manilow songs played very loudly has been

used to try to repel 'boy racers', who use their own sonic appropriation of space through both music from car stereos and engine noise (Jacobson, *The Independent*, 10 June 2006). A constant flux of information about where you are and what is happening is channelled through the sounds of the city.

Filtering the intensity of interactions with this network is possible, while simultaneously adding another layer of interactions, through sunglasses, mobile phones and audio players.

Driving

Drivers operate in and experience the world in a different way to walkers. A psychologist writing on traffic in the 1970s sees the "... the road user as a limited-capacity information processor whose efficiency (and safety) is enhanced or degraded by the highway and vehicle design features, as well as by his or her personality, skills, and impairments." (Shinar, 1978:ix).

This idea of a driver as a poor quality computer in a questionable environment, is a limited-capacity understanding in itself, and seems to imply the road takes the role of software, programming the behaviour of the driver. The cleaner and simpler the programming supplied to this computer, the better the outcome will be.

The body within the environment of the car is now also understood as a hybrid being (Urry, 2004, Borden, 2006, Thrift, 2004). The hybrid is a member of a culture that has developed a very close relationship to the object of the car, and the car as an object that has evolved to cradle the driver (Katz) in a close embrace. The advancing of computer driven intelligence in cars furthers the hybrid aspect of the car, taking the combination of car and body closer to a cyborg, distributing intelligence: "between human and non-human in ways that are increasingly inseparable..." (Thrift, 2004:49). Having control over this hybrid is important; the car usurping the control by too great a degree is not welcomed. Speaking of car models that stop by themselves when they sense obstacles, an internet based car reviewer writes these reservations: "Who's in charge here? Sure doesn't seem to be you, the so-called driver" (Horrell, 2007). One of the pleasures of driving is the feeling of being in control, of having mastery of this powerful and sophisticated machine. If the driver-car *is* a hybrid, the driver doesn't seem to want to be corporeal flesh inhabiting a machine, but rather someone in possession of a harder, faster, more powerful metal body.

Emotional responses expand to cover this hybrid body. Katz studies the emotional response of being cut off when driving and concludes, "[w]hen one is cut off, the offence lies precisely in the understanding that other drivers would treat 'one's' car as an impersonal thing, without harming the car, of which the driver is in-

tensely aware.” (Katz, 1999:45). From this understanding of the driver/car as a hybrid body, one can understand the nature of the driving agent as different from the nature of the walking agent in the city system.

The experiences of the driver are very different from the experiences of the walker. If one considers experience as a form of information, information about the environment, this question of how experience is changed by transport mode be-

comes relevant to a discussion of the complex system.

The driver experiences feelings available in no other way. Ian Borden lists “...grip, friction, sliding, undulation, curvature, inclination, acceleration, deceleration, wind, noise, vibration, direction, vector, ripples, proximity and distance” (Borden, 2006:12).

The car cloisters the senses - kinaesthetic, visual, sound, smell, and touch. The driver requires “almost no kinaesthetic movement” (Urry, 2004:31). The car has evolved to mediate the driver’s experience of the road and the environment more and more, while simultaneously the experience of the driver’s body touching the car becomes more and more sensual (Thrift, 2004:51). The impressions created by the material of the road, its bumps and texture are absorbed by the car’s suspension while the material of the seat and steering wheel becomes smoother and softer.

While the very first cars lacked the shelter of roofs, contact with the air outside the



Figure

43

car has been gradually diffused. Our first family car had no heating or cooling – the temperature outside and inside the car was pretty much the same. On a hot day, you would down all the windows (the winding itself a more direct engagement with the weight of the glass than pressing a button is now), and one knew from the smell where you were. Now, I have filtered air conditioning and the outside air has little impact on the interior. My butcher's car is a later model than mine and in the morning he tells me the exact temperature of every hill and valley he has driven through. The car informs him constantly, but he experiences none of the weather.

What is seen is changed by the car. When driving "objects appear differently... divorced from their original context or function..." and can take on a "purposeless beauty" (Borden, 2006:9-10). The windscreen frames what the driver sees, together with

the mirrors. Urry claims "[t]he environment beyond the windscreen is an alien other, to be kept at bay..." (Urry, 2004:63).

"Through this frame, landscapes become fragmented by driving, rendered into a series of discrete objects, vistas, markings and so on, but also then reconnected and re-synthesized as a sequence..." (Borden, 2006:11). This is a way of framing and sequentialising a narrative in time, a filmic experience (Borden, 2006:11).

Large, bold and bright things are easier to see from the moving car. The smaller, subtler details of the

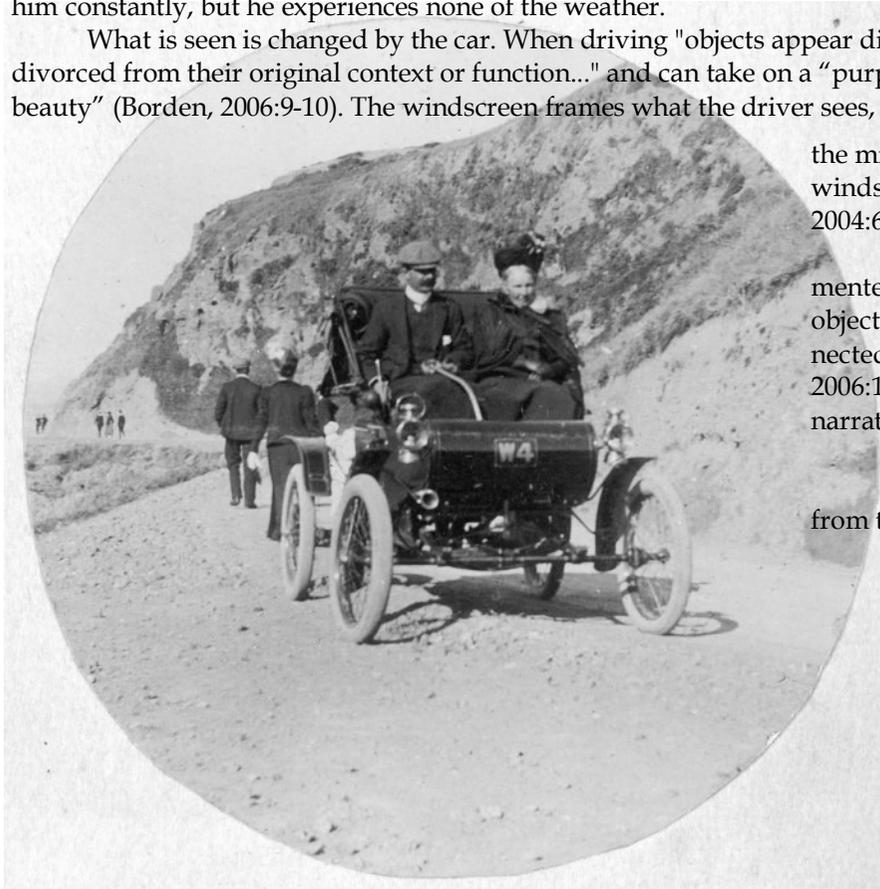


Figure 44

1906 Oldsmobile

city are lost. Lost, too, is any visual information above and below the windscreen. The analyses above all show the car as a powerful mediator of the visual environment.

There is an extent to which driving a car is to inhabit an interior. The car is a type of boundary to both the elements of the landscape and a boundary to interaction. If there is a sense in which interiority is a device that orders interactions, where public space, inhabiting the exterior means one is open to all potential interactions

and to inhabit an interior is to order, filter and limit the interactions one is exposed to, then inhabiting a car is some intermediate place between the very exterior space of the street and the very interior space of one's home.

In other senses the car becomes an interior. One is surrounded by the walls of the car, but also the car can become a very personal territory, a shell holding the necessary objects for one's life – the gym clothes, a cup of coffee, snacks, coats, rugs, water bottles, books, first aid kits.....cars are a means of habitation, of dwelling (Thrift, 2004:49). Entering the car can have elements of coming home. The smell of the car is personal- other people's cars do not smell like home. One touches the familiar textures of the seat, the steering wheel. "Automobiles", says Thrift, "have themselves transmuted into homes." (Thrift, 2004: 46) The driver's choice of music is inserted into the audio-filtered environment, and this choice of sound now "represent[s] the physical presence of home



Figure 45 Signals to drivers

territory" (Arkette, 2004:164).

The city becomes filled with little moving interiors. Engwicht describes this process as "Masquerading as an explorer and traveller, the homebody uses the car to take their home with them into the public domain...Instead of public space providing an ever-expanding sense of home, homebodies shrink their own home territory" (Engwicht, 2005:77). So in the public realm, there are people occupying a type of interior (a hybrid interior/exterior?) while others are occupying the public realm in a fully exposed way; there is a hierarchy of exclusion and seclusion in the space between buildings. The privacy of the car subordinates publicness of walking (Urry, 2000:30).

It is easy to discern the difference voices and their arguments on whether driving restricts and impoverishes the driver, as Urry (and I) do, or whether driving creates a rich and fascinating world, as Thrift and Borden do (Borden, 2006, Thrift, 2004, Urry, 2004). The argument I wish to make is not dependent on a perception of driving as an experience that is either good or bad one for the individual. Rather the argument is that a large part of the interactions of the driver are with the interior of the car and with the ordering systems of the

road, rather than with the wider city.

Ordering of interactions

The driven world is ordered in a different way to the world of walking. The difference in ordering is not just in type but in degree. To even enter the car as a driver requires the ordering devices of licenses and warrants.

Traffic systems seem to be about reducing interactions between drivers as

much as possible. The moment of interaction between drivers is regarded as a point of uncertainty, of risk. Every such point of potential interaction is ironed out ordered. Urry claims that this reduction in interaction makes driven space “a kind of default space or non-place...” (Urry, 2004:29). The first point of interaction that was ironed out was the interaction between drivers travelling in opposite directions, with the introduction of the white line dividing the street. This continued through as many potential interactions as could be managed, with four-way intersections a nexus of potential interactions, all of them potential accidents (a crash being a sort of ultimate interaction between vehicles and/or walkers) and so next to be ordered.

Of course, interactions between drivers are multiple, and hardly completely removed by traffic engineering. The car brand (and any modifications) communicates a lot about the driver. This is, of course, the aim of the branding work of manufacturers: to communicate.

Adding to the communication of the car body is the manner in which it is driven. Some drivers signal their anticipated next move well in advance, with hesitant test moves in their intended direction. Other cars are driven boldly; giving the impression the drivers are unconcerned with other road users. Sounds from the car communicate further, in particular, revving, loud pumping music or toots and honks. Two or three years ago, it became compulsory to use indicator lights to signal at roundabouts, but I found it *harder* to which exit another car was going to use after this regulation change intended to make communication clearer. Watching the angle of the cars trajectory on the roundabout seemed a clearer communication to

me. This contradictory experience was recognised by traffic psychologist Shinar in the nineteen seventies: “...signalization eases the driving task by relieving the driver of some additional visual search...” (Shinar, 1978:163). This ‘easing’ of vision by the emphasis on signalling, limits our input while driving, limits our world.

The display opportunities offered by driving and the car can be sources of pleasure, a reason for driving. The driven ‘cruise’ is a car-based promenade

(Solnit, 2000:66), where the car can intensify the display; what is displayed is not the body but instead the body of the car and what that represents; a display of earning power, consumer knowledge (in choosing the most relevant brand) and the skill or audacity with which the car is driven. A promenade in a car "allows people to remain visually in public but verbally in private..." (Solnit, 2000:66). In this type of cruise, communication with walkers is welcomed, but the car tends to make the walker into an 'other', for "[w]hile many people identify with the driver role, most people tend to think of the pedestrian as someone else" (Shinar, 1978:170). The name 'pedestrian' seems to

emphasise the otherness of people in a different network to us. We watch out for 'cars' rather than people driving cars when we cross the road. People walking are 'pedestrians', a word which somehow brings to my mind an idea of beetles to be studied. This segregation by words works with the segregation of space. I am annoyed when walkers stray on to 'my' space of the road when I drive, yet aggravated by cars interrupting 'my' public space when I walk.

Just as the system of the road and its signals has evolved to work with less direct involvement from the driver, so too the car's signalling has become less made with the body. In the sixties, my father signalled turns or stops with his hands. Today, the task of signalling is taken on more by the car, via indicators and stop lights.

We are capable of communicating fairly well with each other as we drive at the pace necessitated by the density of the city. This communication is a spectrum of signalling with the car body to our waves or nods, but the ordering of the traffic system strives to remove all our distributed communications and instead divert our interactions to linear, single channel communications with the non-responsive machine, or diagram, of the traffic line, the traffic light, and the traffic sign.

8
The patchiness principle
or,
The mineralization of an alternative
street

The patchiness principle

The lack of capacity to use a variety of resources leads to instability...Rule-bound systems, stipulating in advance the permissible and the impermissible, are likely to be less stable than those that develop 'pell-mell' [Skyttner, 2005,103]

So, to maintain a level of stability in the face of changing conditions a system should not invest too much time and effort into one particular way of doing things. (Richardson, 2005:112-113)

The street that is normal to us now, the street of the permissible and the impermissible, is challenged by a street form that appears to have developed pell-mell. This is the shared street, a street stripped of traffic ordering devices, of kerbs and white lines, of traffic lights.

Counter-intuitively, these streets seem to work better than engineered streets. I suggest that this is because the design has catalysed self-organisation.

I aimed to find a way of designing that worked *with* complex systems and walking as a process that co-created space with the morpho-ecological properties of the city system.

Separating or segregating elements of a whole system (by limiting interaction or communication between them) may have the effect of breaking down the whole system. The segregation effected by traffic engineering has perhaps prevented self-organising behaviour to arise on urban streets.

Order appears to paradoxically appear in the shared street. Traffic moves through faster and more smoothly, accidents are reduced to statistically marginal occurrences.

Kauffman describes self-organising behaviour as 'order for free' (Kauffamn:1995:71). Without plans,

without centralised control, interactions between agents creates order.

The shared street dramatically increases interaction. Instead of obeying mechanic controls, subtle negotiations between the people moving in the space occur, probably similar to the negotiations made when people walk in crowded streets, which are understood as an emergent behaviour, as swarming.

Names vary. As well as naked roads, we also have meeting streets (*meetinstrasse* in Ger-

man), also urban rooms. Another name is *begegnunzonen*, zones of encounter. The same presentation also notes the French term *mobilité douce* (mellow mobility) (Thomas, 2006:6). Shared streets seem to have become the most commonly used name.

Mineralization of an alternative street space

It seems the first specific post-car shared street proposal was made by Colin Buchanan in *Traffic in towns*, which was commissioned to study ways of reducing congestion and coming to terms with cars. He proposes what he called environmental zones or



Figure 46 Bangkok lane



Figure 47 Lambton Quay circa 1900

urban rooms. (Ben-Joseph, 1995:505). In his book, Buchanon sees clearly the problems vehicles are causing to the quality of the city space, talking of the “clutter of signs, signals, bollards, railings and the rest of the paraphernalia...” (Buchanon, 1963:28). and sees accepting the visual intrusion of cars as catalysing a destructive attractor state:

...indifference to visual intrusion leads eventually to a slovenly disregard for the quality of surroundings...derelict cars are allowed to stay, the street garbage and litter are accepted for they cannot be swept away, the oil stains and the grease are accepted...And so it goes on. With it all, it can be argued, comes an increasing disrespect for the whole architectural and historic heritage. (Buchanon, 1963:30)

If the America of the time is an exemplar for design based on a wholehearted acceptance of cars, then, he claims, this car-based design is not “leading to the emergence of any new kind of brilliant, lively urban townscape” (Buchanon, 1963:31).

It is from this perspective that he proposes an environmental evaluation of streets and reducing or limiting vehicles in areas with a high environmental quality. The resultant ‘environmental area’ is defined as “An area having no extraneous traffic, and within which considerations of environment ...predominate over the use of vehicles” (Buchanon, 1963:253). In

the abridged edition of *Traffic in towns* there is little other mention of the idea of the environmental area. The large part of the work of this book, discussed in chapter four, is a development of network traffic planning based on forecasted demand. The careful, linear and forceful logic of this work seems to have eclipsed the gentler quest for urban quality.

While his ideas on environment were being edited out of an understanding of the traffic system in England, the idea of valuing the street environment

for those outside cars was embraced as a way of integrating children's play needs with traffic needs in Holland (Ben-Joseph, 1995:506). Particularly in working class areas, the tightness of space in Holland probably helped force the catalysis of what the Dutch call a 'woonerf' or 'residential yard'. The essential rules of woonerven are that pedestrians may use any part of the road; the driver must not go faster than a walking speed and should allow for the presence of others, including children (Ben-Joseph, 1995:506).

The woonerf uses tactics like dog-leg routes, a single grade and obstructive parking, planting boxes to slow traffic, is the suggestion that concrete pavers are one of



Figure 48 Woonerf

the best surfaces because the vibrations created by driving over them slow drivers down and decrease stopping distance for braking cars (Ben-Joseph, 1995:506-507). In a positive feedback loop, Dutch concrete paving manufacturers began to advertise the benefits of woonerven, in order to promote their products. Increased production runs caused by the building of woonerf may have reduced the cost of concrete pavers, making pavers cheaper to buy than laying tarmac roadways making woonerf cheaper to con-

struct than standard roads, increasing the acceptability of the woonerf, increasing again the production runs of concrete pavers....

The woonerf is a residential design, but woonerf-like space materialised in a more urban situation in an accidental way. Hans Monderman, a Dutch traffic engineer, was asked to design for a township that didn't want any of the usual traffic calming tools he relied on. Left without his usual techniques, he decided just to make the streets look like those in a traditional village. To

his surprise, this transposed traditional form was more successful than traffic calming. Speeds decreased by 50 per cent compared to only 10 per cent when standard road calming techniques were used (Engwicht, 2005:53).

The degree to which a shared street is stripped of traffic ordering devices can vary. Monderman's design in Oosterwolde removes all traces of ordering. There is absolutely no distinction between driving space, walking space or parking space. All space is to be used as people decide between them at the time (Hamilton-Baillie, 2004). Blind people have expressed concern over their safety in shared streets. As a result of this concern, zebra crossings were added to the Laweiplein shared space (Leeuwarden, 2007:23), but Monderman's would walk through shared streets backwards, or invite interviewers to walk through with closed eyes, all without mishap (McNichol, 2004). This would appear to be related to a redundancy of resources effect. Removing the ability of a single agent to



Figure 49

Monderman design:

Oosterhaus

interact, here Monderman, unable to make eye contact with other traffic has not caused a collapse of order (an accident). Instead, the large number of other interactions has maintained the robustness of the system.

If one considers the history of road engineering, it is not surprising that traffic calming devices are not the most successful way of calming traffic. Effort and thought and calculation have again and again gone into trying

to form the road in such a way that traffic can flow quickly and smoothly. To then apply, on top of that system, devices to make the traffic flow more slowly is to create a system where one part is working against the other.

Confirming the morpho-ecological nature of the street, shared streets can be created by a bottom-up, subversive use of space which also creates a shared street without changing the built form of the street. Alternative patterns of use, and the signs of these uses, can change driver's expect-

tations of the purpose of the street.

Playing in the streets comes up again and again in the study of shared streets. In New York, after streets were sealed and the faster traffic hindered street play, boys would recreate their street play space by sprinkling broken glass on the road (Hart, 2002:137).

David Engwicht has explored this bottom-up sharing of street space as a 'social inventor'. His inhabitation based methods were accidentally found, as Monderman's form-based methods were. Engwicht organised a street party as part of a preparation for traffic-calming in a residential street. The residents soon told him how much they appreciated the new traffic calming measures. This rather surprised him, as none of the proposed traffic-calming measures had yet been made. The act inhabiting the street for the party had changed perceptions of the street in the neighbourhood. It now seemed to be

regarded as a space your neighbours might be inhabiting in some way, rather than as a space to drive through as quickly as possible on your way to somewhere else (Engwicht, 2005:10).

Engwicht uses signs of inhabitation to effect - he may hang a child's tricycle up say that this space has children playing. He also believes that acts like this engage drivers curiosity and interest (Engwicht, 2005). I like the way this changes the street space from a field of purposeful movement to a space with a rich narrative.

Engwicht describes changing a street in a performative way:

So I set the chair [a 'street reclaiming' chair] up right in the middle of the intersection outside the hall, taking up about as much space as a mini-roundabout. Soon the traffic began to back up as each driver queued to ask me what was happening. The cue got longer if I took longer to answer their question. But



Figure 50 David Engwicht on his street reclaiming chair.

there was something very un-American about this traffic queue - no one got angry. Instead there were waves, smiles, good humour and lots of banter. One driver even asked if I minded him joining me. 'Be my guest', I replied, not having a clue what he meant by joining me. He parked his car, went to the truck and took out a flute. He came over and began playing classical music and dancing around my chair. All this activity caused people to come out of their houses. For some reason, the fact that I was in the centre of their street seemed to legitimize residents holding their conversations, not on the sidewalk, but right in the middle of the street. Kids brought out their bikes and pedal cars and began riding around in the street. And the motorists continued to queue patiently...(Engwicht, 2005:19-20)

This performative inhabitation seems to have completely transformed the use of this street. How the mode of inhabitation can change the interpretation of the space is discussed further in the section following, on space phase change.

Movement phase change

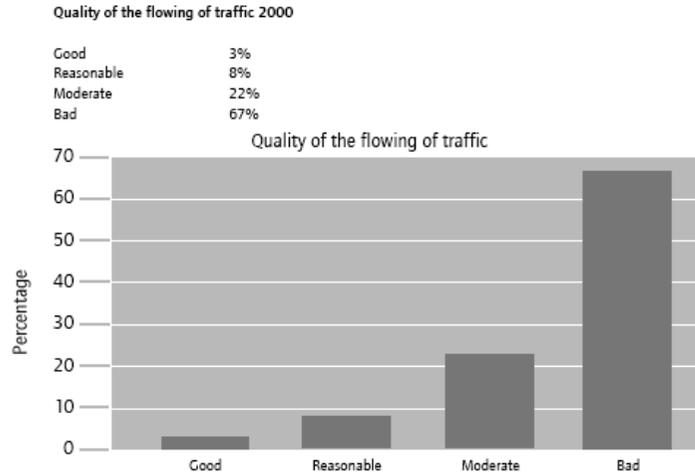


Figure 51 perceptions of quality of traffic flow, Laweiplein, before

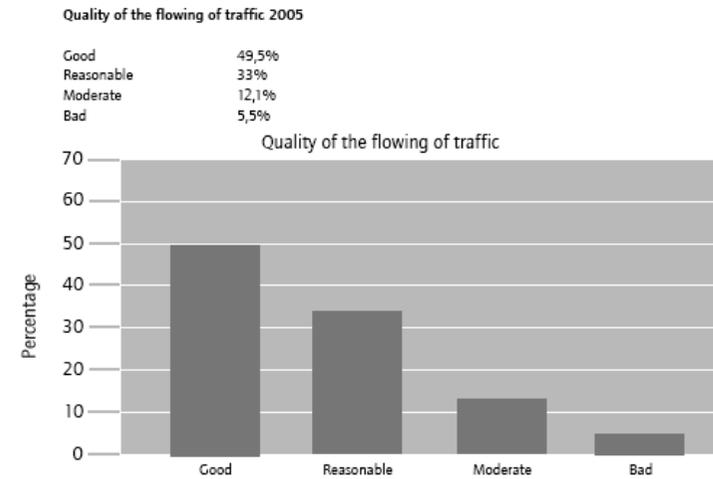


Figure 52, perceptions of quality of traffic flow Laweiplein, after

Figure 53 Laweiplein, before and after

'Before' and 'after' charts like this are rare. This is not a picture of an incremental change. This is something much more like a phase change, a sudden shift from one state to another,

one of the hallmarks of complex systems.

Further results from the report on Laweiplein show a reduction of delays for traffic using the space, from a peak average of 50 seconds to 30 seconds. This was not only less than the previous times but also less than the time predicted by roundabout models. Bus transit time changed from 56 seconds to 23 seconds. (Leeuwarden, 2007:6).



Both drivers and cyclists felt the junction was less safe than before, but pedestrians felt safety was the same. This was in the face of a large reduction in accidents. The report speculates that this perception of safety reduction make people drive more safely.

Communication becomes body to body- a change from pedestrian/ car to walker/ driver in these spaces; participants are not relying on the system to order their movements. Instead there is a necessity to communicate directly with the people, as bodies.

Walkers move with constant readjustments and constant awareness of other bodies in space (needing agent -base models to replicate, an indication that it is self-organising behaviour) and driving becomes changes from a reduced, linear pattern of movement to one of awareness and readjustment.

Woonerf design catalysed increases in play where they were built. Emergent be-

haviour resulting from increased interaction, play was not only more frequent but more complicated and involved in the woonerf (Ben-Joseph, 1995:510). As well, overall accidents were reduced by 20 per cent, serious accidents by 50 per cent (Ben-Joseph, 1995:510).

Another phase change appears in the processes of shared streets. At speeds below 30 kph, there is an abrupt drop in pedestrian injuries caused by cars. (Hamilton-Baillie, 2004). This type of transition appears to be a phase transition, a hall-mark of complex systems.

Swarming

William Whyte spent five years filming and analysing street life, mostly in New York. Among his many observations is a study off how walkers negotiate their trajectories with each other. His observations are repeated here:

Up ahead the pedestrian
spots someone advancing
on him. When the two
are about twenty feet

apart, they will look at each other. This is a critical moment. By their glance they must not only convey the signal but see of the signal has been acknowledged. A few feet nearer they drop their gaze and make a slight shift in course...the step and slide. The course shift in itself is not enough for a full clearance but it will be enough if the other pedestrian makes a comparable move, as with few exceptions they do. (Whyte, 1998:57)

When two pedestrians approach diagonally

- "In addition to the simple pass, you now may instinctively use ...a retard - a slight, almost imperceptible slowing that

will avert a collision course...the retard takes place within...one fiftieth of a second or less.” (Whyte, 1998:58)

Whyte’s descriptions of walkers organising their movements in ways that are extremely efficient in terms of carrying capacity are borne out by agent-based modelling of pedestrian movements (Helbing et al., 2001). Agents using rules similar to Whytes create patterns that closely follow those observed on streets.

[People] will split into an infinity of directions. Some swirl around the information kiosk clockwise, some counter-clockwise. Hundreds of people will be moving this way and that, weaving, dodging, feinting. Here and there someone will

break into a run. Almost everyone is on a collision course with someone else, but with a multitude of retards, accelerations, and side steps they go their way untouched.
(Whyte, 1998:67)

This sounds very much like the descriptions of movement of cars, bicycles and walkers in the shared, self-organising street as watching “a giant concrete mixing bowl of transport” (McNichol, 2004).

Monderman does not regard potential conflict

between those who, say, want to park in a shared street as not a problem. "Why are planners and engineers so frightened of conflict? Conflict is a normal part of the democratic process in the social world. When we try to eliminate conflict by over-regulating physical design we actually weaken the evolution of a robust and vibrant social world" (Monderman cited in Engwicht, 2005:54). Complexity theory confirms conflict as a source of robustness in a system. Kauffman studies evolutionary systems of 'patches' in competi-

tion, and finds systems with competing patches evolve to find optimal solutions to difficult problems (Kauffman, 1995: 266-269).

The nature of attention changes in different spaces. Traffic engineering assumes attention is limited (Shinar, 1978:ix), but Monderman argues that treating people as if they are stupid means they will behave stupidly (Engwicht, 2005:46). Putting drivers in a position where they have to pay constant, close attention to their surroundings may help driving in a way that reduces accidents. After driving for several years on Asian roads, where all manner of vehicles - from rickshaws to army trucks - came at you from all directions and with little regard for 'normal' road rules, I moved to Canterbury, where I found driving required so little attention due to the long, straight roads and orderly progression of other vehicles that I was constantly petrified I would doze off with boredom.

It seems traffic engineering works to always reduce the amount of attention the

driver needs to pay to the environment. The response to accidents is to make louder, larger, brighter signs and markings, as is making sure that no non-permitted people stray into the motorists' space. This is the correct management of limited-capacity computers. But the human is not a linear computer; we surprise ourselves with our counter-intuitive complexity. Requiring less attention of us means we pay less attention. We pay less attention, so we continue to have accidents. Traffic is therefore modularised further – another attractor state has been created.

...the amount of attention allocated to the driving task is determined by the situation – it increases as the driving demands increase and decreases with corresponding decreases in the demands of the environment. (Shinar, 1978:73)

Schreiber is aware of this vicious spiral in the nineteen sixties:

"... the more one does to spoil the driver, the less he concentrates" (Schreiber, 1961:230).

It is not until the shared street is built that this non-linear reasoning is allowed its place in the street. Without traffic signals, attention is focused on the street itself and the people in it, creating a richer flow of information.

Space phase change

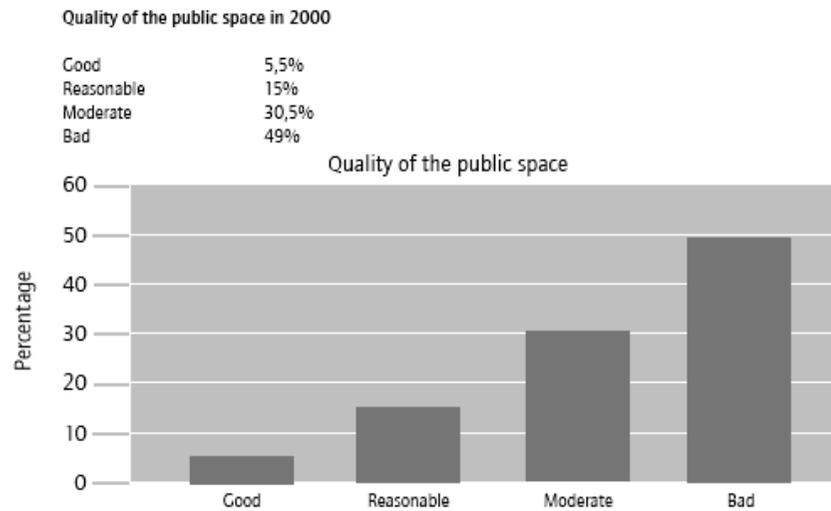


Figure 54 perception of quality of space

, Laweiplein, before

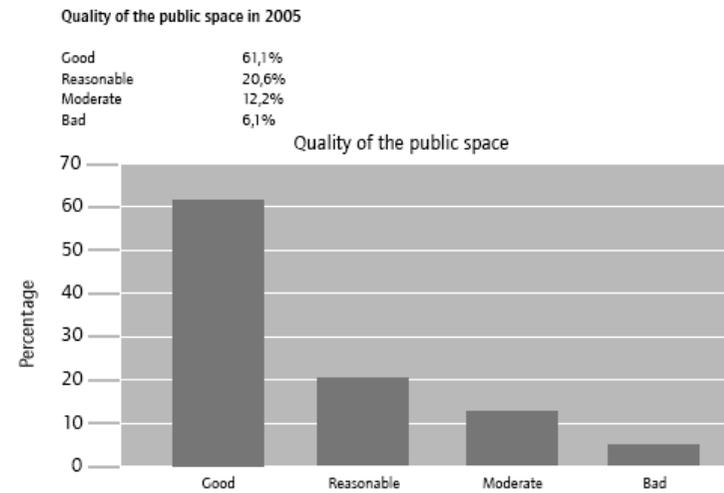


Figure 55 perceptions of quality of space,

Laweiplein, after

In a remarkable echo of the phase change in movement, there seems to be an almost identical phase change in the perception of space. What do the respondents here mean by 'quality of space'? We cannot know exactly without some further research on user perceptions. Here I consider some ways in which the space could be understood to have undergone a phase change.

Inhabitation and the room

The wonderfully dramatic Stadtlounge (city

lounge) by Pipilotti Rist and Carlos Martinez was almost never built. In an interesting commentary on the feedback processes of juried design competitions, this design was one of six finalists for the redesign of Galen, Switzerland. Swinging towards a perceived norm, none of the jurors voted for Stadtlounge and instead became deadlocked between two more standard designs. An outsider was brought in to break this deadlock, and they uncovered the fact that every single juror secretly preferred Stadtlounge but had not dared to vote for it (Thomas, 2006:7). Rist and Martinez called their design city lounge as the design intent is "creating the illusion of private space within public space" (Rist, 2007:68). As a result, "... driving feels like intruding into an intimate space" (Thomas, 2006:68) - the space feels immersed in the field of the red 'carpet'. Martinez explains the simultaneous sensations of both sports ground and carpet as combining to create a new ex-



Figure 56 Stadtlounge, Pipilotta Rist & Carlos Martinez, Galen, Switzerland

perience (Martinez, 2006:28).

The words used to describe these spaces (i.e. urban room) emphasise that these spaces change from spaces to move through to spaces to inhabit, to live in. Stadtlounge in particular plays with this and Engwicht works through inhabitation as a catalyst towards a remaking of the space first, with design *following* inhabitation.

This advanced anatomy [of corridor rather than enfilade] made it possible to overcome the restrictions of adjacency and localization. No longer was it necessary to pass serially through the intractable occupied territory of rooms, with all the diversion, incidents and accidents they might harbour... these thoroughfares were able to draw distant rooms closer, but only be disengaging those near at hand. And in this there is another glaring paradox: in facilitating communication, the corridor reduced contact (Evans, 1997b: 79).

Important in this section is Robin Evans discussion of the corridor. In the same way that the street was solidified into separate domains of footpath and carriageway, the corridor changed the interior from enfi-

lade of rooms for both inhabitation and movement into separate domains for inhabitation and corridors for movement (Evans, 1997b). One could describe the evolution of the engineered street by appropriating his sentence

At first it is difficult to see in the conventional layout of a contemporary house anything but the crystallization of cold reason, necessity and the obvious, and because of this we are easily led into thinking that a commodity so transparently unexceptional must have been wrought from the stuff of basic human needs. (Evans, 1997b:56)

only substituting 'street' for 'house'.

The interpretation that the separation between footpath and carriageway is designed to keep walkers out of the way of the higher caste of car owners is a parallel to this the way the corridor was able to keep servants "out of the way of gentlemen and ladies" (Evans, 1997b:71).

Another parallel is the understanding Evans has of the room becoming a space for inhabitation only and the corridor a space for movement only. In the pre-car city, the

Figure 57 In 1889 Camillo Sitte describes and praises the Piazza del Signori, Verona, "used as much for vehicular traffic as by pedestrians" (LeGates & Stout, 1996:423)

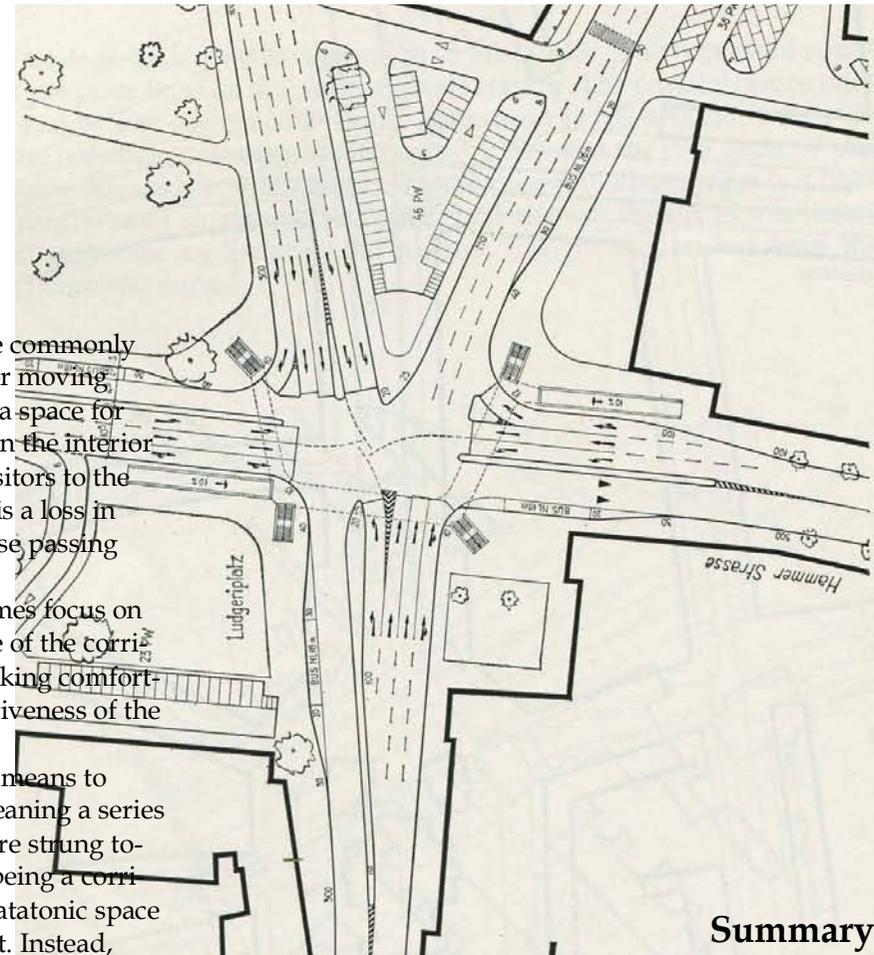


street was for living in *and* moving through. In the commonly accepted model of the city, streets are now only for moving through and parks have been assigned the role of a space for public inhabitation. And just as Evans sees a loss in the interior life of chance meetings between occupants and visitors to the house as a result of this spatial segregation, there is a loss in interactions in the contemporary city between those passing through and those inhabiting public space.

The work of making an interior can sometimes focus on the beauty and comfort of the room at the expense of the corridor. So too the city focuses on beautifying and making comfortable the park and ignoring the comfort and attractiveness of the street.

Enfilade is derived from a French word that means to string beads together. In architecture, it is term meaning a series of connected rooms, rooms arranged as if they were strung together. The shared street changes the street from being a corridor, only a graph of the street, a thoroughfare, a catatonic space that is devoted to the vectors of choked movement. Instead, streets are spaces strung together, enabling movement, but the space of the street becomes something in itself, something more than a line, a direction, and it becomes somehow whole.

Figure 58 City as traffic graph



Summary

When first thinking about how to envisage walking in the city as an ecological problem, and thinking about how to set up an agent-based model, I could only mentally model the car as predator and the pedes-

trian as prey. In such a model, when one wants to lose none of the prey species (as with pedestrians, where death is not an acceptable outcome), completely segregating the prey preserves them completely, like birds on a rat-free offshore island. But it seems wrong to model car drivers as predators even though they are quite capable of killing and maiming walkers.

We are the same species and it is devastating rather than a necessary part of life to accidentally kill another person by car.

Shared space design can be regarded as uniting the segregated driver and walker. The word used to describe people walking, pedestrians, seems to imply that walkers are other, not us just getting around, but almost be a type of very boring beetle integrated equally into the concept of subversion.

The opposite in this transport dichotomy - people driving -is no longer termed anything to do with people, but is now a car, vehicle(s) or traffic. The human is not even present here; the words only refer to the machine or the flow of machines.

The closely coupled nature of morpho-ecologies means that design is more than form finding, it is considering the process as much as the form. For movement design, this means how we all move through the city is a multiple act(s) of design. To walk is to design a walking city; to drive is to design a driving city. Acts of inhabitation produce a habitable city.

The network structure of movement is also changed, adding a lot more connections to the walked network, adding layers of communication to the driving network.

Shared street design alters the feedback loops. The designs explicitly value walking. The walker has priority. The quality of the materials tells walkers they are valued.

Territory perceptions change in the woonerf; residents seem to feel the shared street is part of their territory (Ben-Joseph, 1995:510), in contrast to the divided street. Perhaps a similar territorial shift occurs in urban shared streets. To whom the city streets belong is important. Lawson claims that ideas of territory are very important in city making; that competition for central territory creates "their very character and attrac-

tion" (Lawson, 2001:174).

Fractals and information

Salingaros, a mathematician applying complexity to urban design theorises that fractal relationships in form are not only attractive, but that formal relationships *must* be fractal in order to be perceived as beautiful (Salingaros, 2004:44). This argument does not completely convince. There must be a number of non-fractal creations that have been found beautiful by somebody. Rather than arguing this point, I can agree that fractal proportions can be beautiful.

Shared street design changes the proportional relationships of the street. They are no longer divided into strips of footpath and carriageway; instead, the space between buildings is read as a single space. When looked at this way, a rough drawing shows that the proportions are now more closely following a fractal curve than before.

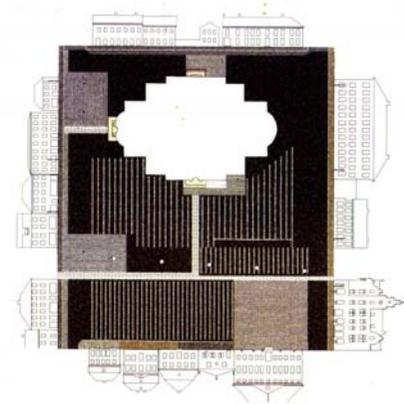
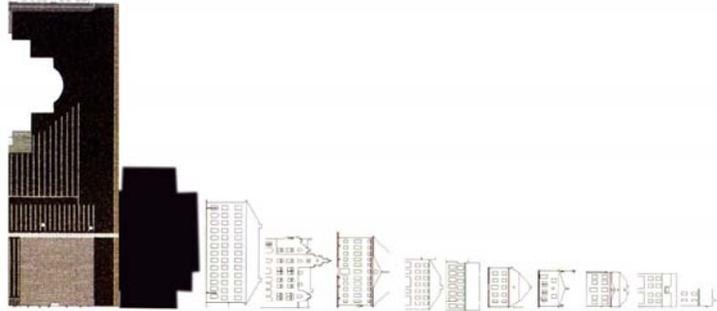
The stuff of traffic is often unseen, chosen to be unseen. On a landscape painting field trip I went on, all the participants immediately chose a position where there were no poles, lights or signs to blight their paintings. When looking for beauty, they tried very, very hard not to look at any traffic engineering.

Information is signal, junk is noise. This ratio is part of complexity

theory in this way: no noise in the system and emergent behaviour is unlikely, some noise and emergence more likely, too much noise and the system becomes chaotic rather than complex. think of genetic mutation as noise in the system of reproduction- without it there is no evolution, too much and survival is compromised (Kauffman, 1995:182-184). There is a lot of information in the urban environment. Are all these signs and so on junk, too much noise without information? Are they tipping the city from complex to

**Figure 59 Stortorget square, StJohn & Lofdahl,
Kalmar, Sweden, 2003 and**

**fractal relationship of surface planes (top),
adapted from original drawing (bottom) by StJohn
and Lofdahl**



chaotic?

Traffic signage is designed to be as highly visible as possible but has somehow have come to be a not-visible background. Tufte talks about information design and how to communicate a lot of complex information visually (1990:51). I think he would interpret all this information screaming out in high-vis yellow and red as actually restricting the reading of information. A large amount of 'highlighted' information becomes a background, in which no one piece of information is able to be seen.

Looking at pictures of interaction streets, I have a sense of peace, a feeling of relief from pressure. Possibly images of traffic-stuff-signage have been used so much to refer to city stress that taking away, this symbol of stress feels like taking away stress itself, but arguably all the traffic knick-knacks are visual stressors in themselves. We attempt to block them from our sight unless we actually need their directions at that point.

9

**An infrastructure of interaction in
Wellington,
with help from the relaxation time prin-
ciple**

Relaxation time principle

The relaxation time principle states that 'system stability is possible only if the system's relaxation time is shorter than the mean time between disturbances' ... So, for any complex system that is initiated from a certain set of conditions, or is pushed into a certain set of conditions from external factors, there is a transient delay before the system will reach its characteristic attractor...Given that there is often a delay between any transient state reaching an attractor state, it *seems* obvious that if the time between external disturbances is shorter than the relaxation time on average then the system will rarely get the chance to settle down to its characteristic behaviour. (Richardson, 2005:110-111)

The model of cars as predator is faulty but fruitful

My early thoughts, based on a model of ecological corridors (also known as green corridors) catalysed a focus on shared streets in this thesis. This is reflected in a changing use of words to describe the design ideas that occurs as the focus shifts from street as corridor to street as room.

The parts of ecological corridors are: core area, stepping stone corridor, landscape corridor, linear corridor, buffer zone, surrounded by sustainable use areas (Linehan et al., 1995). Translated to the city, the 'core area' could be an urban park, where pedestrians

safely collected, preferably with attached cafes or other feeding facilities. A 'linear corridor' would be a pedestrian mall, where pedestrians could move between core zones without fear of predation, and with a full range of sites for specific types of interaction along the way – offices, shops, libraries and so on.

Pedestrian refuges, the landing spots in the middle of roads, are 'stepping stone corridors', allowing the walker to move with piecewise moments of safety in the city.

'Buffer zones' are created by traffic calming devices or 30kph speed zones, making spaces where pe-

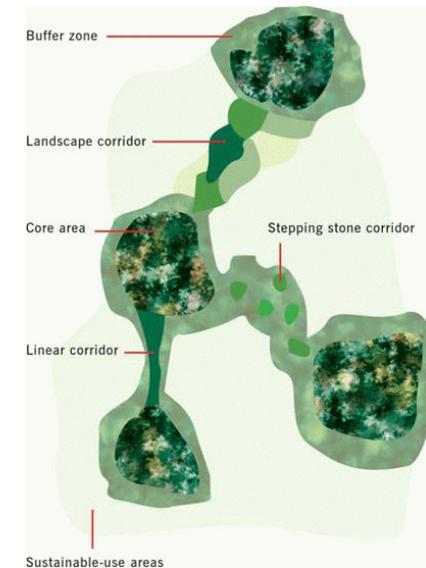


Figure 60

**Ecological
corridors**

pedestrians are somewhat protected.

The 'sustainable-use surroundings' must be parts of the city where the ordinary traffic rules of 50kph speed limits are in place and some pedestrian space exists - some sort of footpath, and some reason to attract them. 'Unsustainable surrounds' would be motorways, freeways, and dispersed, footpath-less edge zones.

Jaywalking as inhabitation

My focus is on the interactions between walkers, drivers and the space of the street. In thinking about how to apply and site the ideas I am looking around at principles of shared street, I look at one particular type of interactions between walkers, drivers and space - jaywalking.

Jaywalking is a type of negotiation between walker and driver (Creedman, 2006:14). More than that, it is a claiming of the roadspace by the walker, a disruption of the ordering of the traffic planner. Moments of jaywalking represent moments where movement is negotiated through interaction.

Engwicht points out the performative aspect of street remaking and says acts like sitting in chairs on residential footpaths can change the interpretation of residential streets from 'space for driving' to 'space for people' (Engwicht, 2005:93). Jaywalking could be a similar performative catalyst to the perception and interpretation of the city

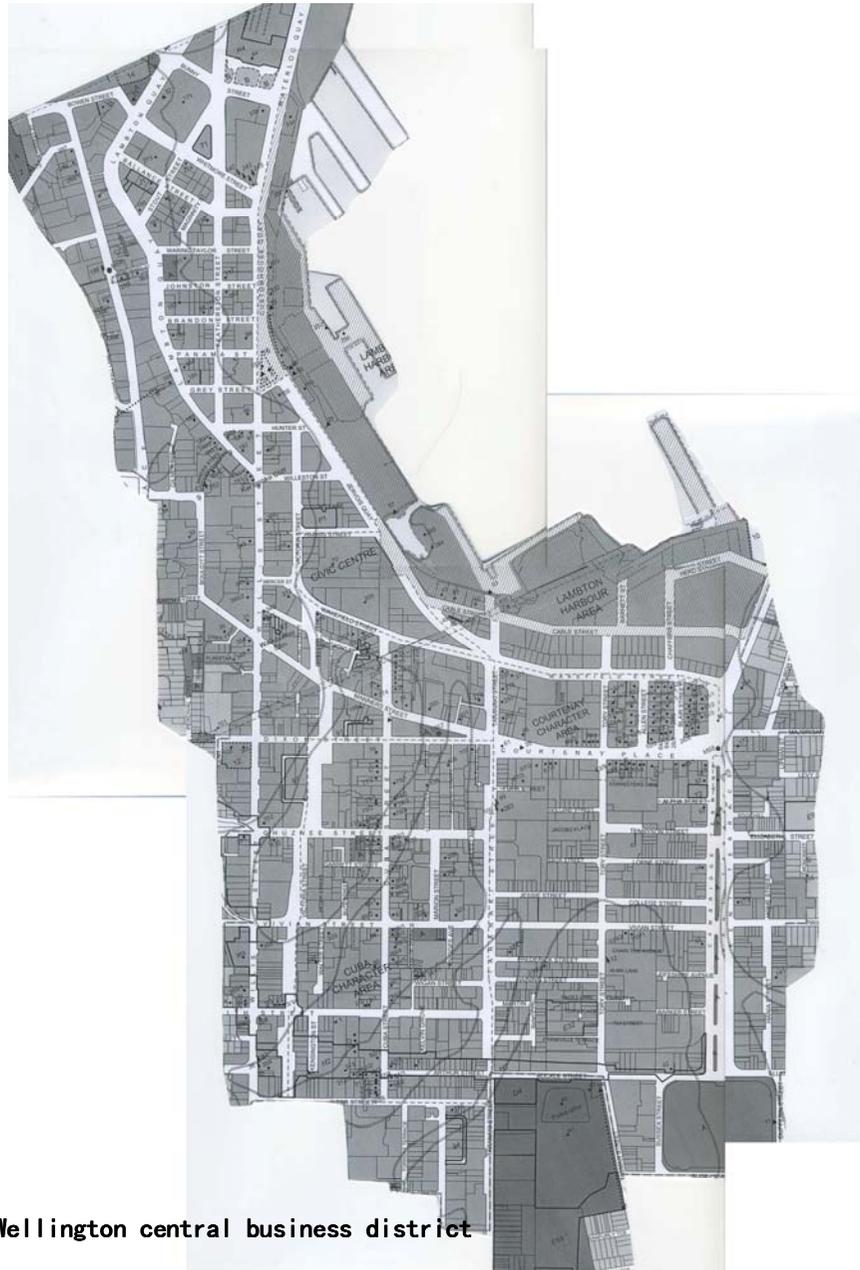


Figure 61 Wellington central business district

street. The report on Laweiplein found that on the streets with fewer pedestrians, cars were less likely to give way to them (Leeuwarden, 2007:24). If shared streets were sited in places where walkers already were making large volumes of negotiations with drivers, I believed resultant shared streets would be less likely to slip onto a possible car-dominated state.

Method

I walked every street on a map of Wellington's central business district with the exception of some very small dead end streets that were empty of walkers when I passed them.

A bypass had been only recently opened and I felt the area affected by it not had time for the walker/driver/road system to settle into new patterns of response; the relaxation time principle means that systems take time to settle into new patterns after disturbances, so I did not include those areas. As I walked, I marked every person ahead of me I could spot jaywalking. This method meant there were discrepancies in

data collection as a result of differences in the street layout or topography. Some streets were straighter and had better visibility than others and sometimes I had to walk at a slower pace, so I could have missed any number of jaywalkers.

Patterns of jaywalking change with time and weather. The days I walked were all sunny winter days and I restricted the times of mapping from 10:30 -12:30 and 1:30 -3:30. I initially chose those times because my children were at school then, but feel

this was a reasonably good choice of time as people moved at a pace and density at that time that was easy to record. My aim in applying these restrictions was to record jaywalking in close to one condition throughout the city site. Different patterns of movement arose during rush hours, lunch times and night as well as on rainy or windy days. It would undoubtedly be a much more complete understanding of jaywalking patterns in Wellington to map a range of times and conditions, but my plan was not to present a rigorous, definitive plan for Wellington, but rather to make an indicative exploration of a siting and connecting process.

I soon found out that there were many ways of jaywalking, with different meanings. In Cambridge and Kent Terraces everyone who crossed the road, with the exception of one woman pushing a pram, jaywalked. Traffic lights were so widely spaced that there was a five minute walk between them and once at the lights, it took two or even three complete cycles to cross the roads.

On Jervois Quay, nearly everyone crossed the road the 'right' way. There was just no point in crossing the road; all the buildings on one side had blank walls on the street - even the parks on the seaward side are well barricaded. And there is no footpath!

Courtenay Place also had few jaywalkers despite the high walking density. Here, in contrast, there were so many zebra crossings along the whole length of the street so that a walker had little need to either jaywalk or wait for a traffic signal.

The bodies of the jaywalkers spoke. Scuttling or running across, with

the body folded in on itself in fear indicated a jaywalker was not feeling in control of the road space; on the contrary, they felt very threatened. A type of bravado could operate, signalled by determinedly not looking at the cars or driver: the jaywalker steps out, daring the driver not to run them over. Bodies are held with a type of self-awareness, almost a posturing display of risk taking.

Others would establish some communication with the drivers, indicating by their body position

they intended to cross the road and then, waiting for the drivers to communicate either by eye or by the slowing of the car (or not, as the case may be) before crossing.

A strong indication of inhabitation, of 'ownership' of street space was when jaywalkers cross the road with maybe just a glance at the traffic and then proceed at their normal pace, body relaxed. They just know they are fine. Routes taken by jaywalkers were often at right-angles to the direction of the footpath, minimis-

ing the amount of time they spent on the carriageway. The relaxed, street 'owning' jaywalker often followed their desire lines, cutting across the road at wide angles or even curved paths, spending lots of time on the road.

The most emphatic examples of street inhabitation seemed to happen when people walked straight down the centre of the road, barely making contact with the footpath.

Blair and Allen Streets are already shared space designs. There is no major level difference between carriageway and footpath, except for a clever dip that keeps the front wheels of parked cars from going onto the footpath zone. When I started mapping Blair Street a group of men walked casually down the centre of the street, three abreast. They were signalling very clearly that the street was 'owned' by walkers, and perhaps other people followed their example.

I had made an assumption that pedestrian only spaces would alter a jaywalked

inhabitation of the surrounding roads; walkers would act as if they were entitled to use the space of the street freely for some time after the pedestrian zone ended. This appears to be borne out by the jaywalking mapping results. There is a response in behaviour initiated by the street design.

Network of sites

I would be very interested to see what would happen if a whole city became a site composed entirely of self-organising streets, of zones of encounter, but the question arises of where the city is and isn't. One of the consequences of complexity theory is that a city can act as a 'whole', an entity. It can come into being at a specific density of interactions and disappear if that density of interactions drops away.

But although the city is located in space, a city of flows is not defined by space. It is defined by the flows, and these flows change. Late on a Friday night, the city (of Wellington) exists in the Courtenay and Cuba areas while Lambton Quay is more like a desert than a city. On the night of a big rugby match, the city becomes located to the north.

Theoretically it becomes unappealing because it is a bit of top-down design, where I, the Designer, says this street is 'in' the city and that street is 'outside' the city.

The whole point is I am working with a morpho-

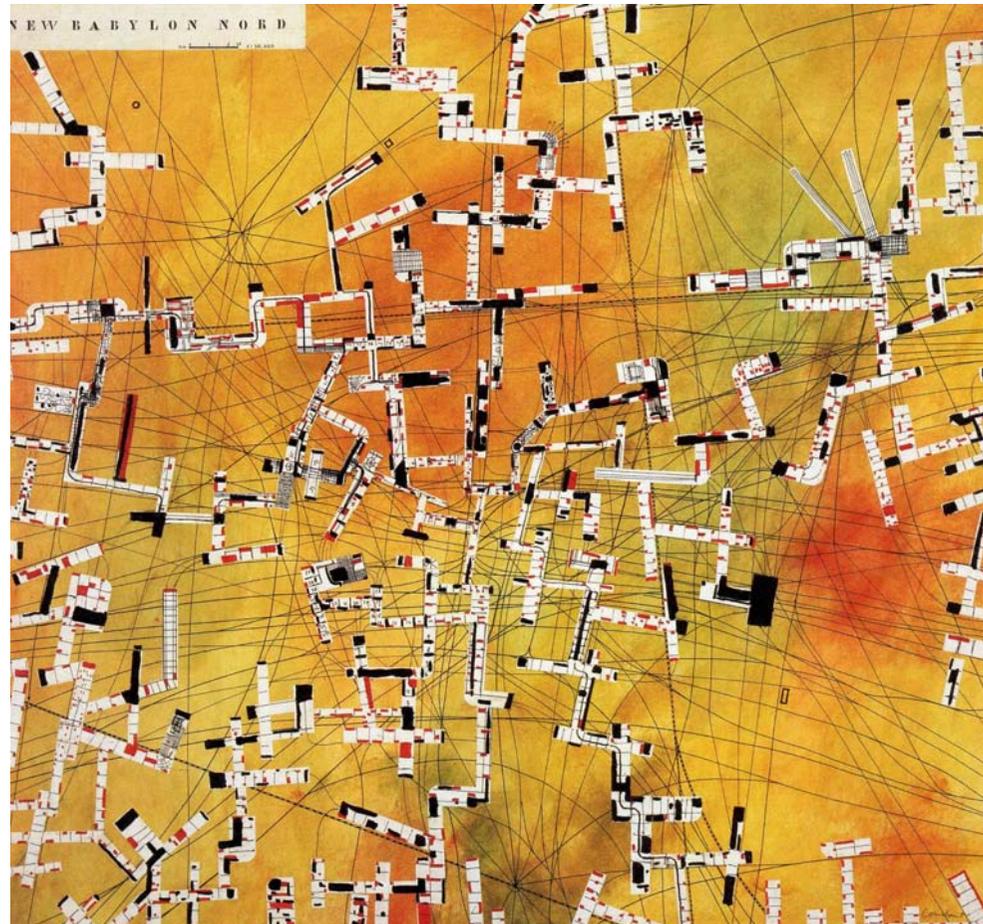


Figure 63

New Babylon Nord,

Constant, 1958

ecology. The city of flows is a responsive network, and working with nodes is maybe a little like working with acupuncture. I try and find certain flows, maybe areas that are blocked, maybe where the flow is going well and can be extended. These areas I act on. Hopefully catalysis occurs, a phase transition, in these points. Another reason not to proclaim 'the city is here but not there' is the darkness principle. I cannot 'know' the city, perhaps not enough to say where it starts and ends. It is probably more rigorous to read the traces of the system.

However, the holism principle implies there *is* a whole entity - the city. Monderman believes there are two distinct types of street space; the social world and the traffic world. and that some type of boundary definition is necessary to tell the driver they have arrived in the social world (Engwicht, 2005:42-43). One can envisage something like the old walled city arising from this approach. I like this idea, but I like even more the idea that the 'social world' can reach out into the inner suburbs in unanticipated, tentacled ways.

With connected rooms, the situation had been quite different. There, movement through architectural space was by filtration rather than

canalization, which meant that although great store might be set on sequential passage from one place to the next, movement was not necessarily a generator of form...with the matrix of connected rooms, spaces would tend to be defined and subsequently joined like the pieces of a quilt, whilst with the compartmentalized plans the connections would be laid down as a basic structure to which spaces could be attached like apples to a tree.

(Evans, 1997b:78)

Intervention over time

The response of the city, by the city, needs to be an explicit part of the design process.

After the initial interventions, a remeasuring should be made. Where is the walking flow strong as a result of the changes? How has the pattern of inhabitation, of jaywalking changed?

How too has the inhabitation of buildings changed? There will probably be changes in use as a response to changes in movement.

When this is done, after the effects of the intervention have been observed, the next step is to find out where the city has decided the shared streets should be extended to.

The approach of continuing to test the effects and alter the implementation of the following stages in response to the test results is not the same as staged design, where a master plan that remains essentially the same but is slowly implemented, but a system actively engaging the morpho-ecological responses of the city. It is an attempt to fully engage with the time relaxation principle, and observe the responses as the system settles into new attractors over time.

Process design matters as much as physical design- “think of structure not as a static object but rather as a process of material opera-

tions” (Menges 2004:84).

The challenge is not to slow everything down but to enable situations that support an infinite variety of fast and slow moves- dictated by us, not by the system. Ivan Illich described the speed issue as a prison, out of which there is no exit, when it's presented as an either /or choice; ‘We discuss fast and slow, endurable and destructive speed’ . (Thackara, 2005:44)

Connecting networks

Once the principle of self-organising traffic is accepted, at least for city spaces with dense walking-driving interactions, it becomes important to consider how other transport networks interact with these spaces. In going through the drawing process, integrating the existing bus-lanes and one-way streets of Wellington presented problems.

Bus lanes

Bus-only lanes in Wellington work through the central city stretch that has been

designated a transportation corridor. While an efficient public transportation system is extremely important, and I would have regarded bus lanes as a positive move when I started this research, I have had to question their use in the inner city as a result of thinking about complexity and traffic.

One effect of using bus-only lanes in streets with only one lane in each direction is that cars cannot go in both directions in a number of streets. This intensifies the one-way street effect discussed below. I would argue that reducing car numbers in the inner city is excellent, but the advantage of cars over public transport is their high spatial connectivity. To reduce the connectivity of the city to the degree that the combination of one-way streets, bus lanes and bus only streets do is a worry. We do not know at what point the reduced connectivity will have a possibly catastrophic effect on the city. There are tipping points where, if cities be-

come too hard to get around in normally (and cars are currently considered normal), people will go to suburban shopping centres or malls in preference to the city, reducing connections in the city.

Another problem with streets dominated by buses is something that might be described as brittleness in the movement system. In a road that carries cars, bicycles, motorbikes and walkers/jaywalkers, buses have to go slowly and carefully - exactly what bus lanes are trying to pre-

Figure 64



vent, really. With the bus lanes, buses are fairly free to move at the maximum road speed. Unfortunately, bus bodies do not seem to be designed in any way to improve safety when they meet the human body head on. Not only do they have tremendous mass and therefore tremendous momentum, but they appear to have none of the protective front end geometry of the sedan car (Simms and O'Neill, 2006:6). The bonnet of the sedan car is designed to scoop and flip a pedestrian to the side in the case of an accident. SUVs do not have this; their flat front ends batter the pedestrian down. As an untrained guess, buses would appear to have as poor a front end geometry as the SUV.

In Willis Street two other problems with bus only lanes can be seen. People still jaywalk. In a street with cars as well as buses, jaywalkers have a high visibility in between cars. Watching jaywalkers pop between the enormous bodies of buses is truly scary. They can see nothing coming, no one can see them coming.

In fact, Wellington seems to have developed a real problem with bus induced fatalities.

The other problem in Willis Street is that the huge numbers of buses have made the street much less pleasant to be in. To repeat, I have nothing against buses in themselves, but to be in a street that is a canyon of looming, noisy metallic bodies and clogged with diesel fumes is quite unappealing.

To return again to complexity theory, if we have a self-organising street area, how can we have 'designated' bus lanes? I predict that this top-down permissible/non-permissible thinking will interfere with the needed bottom-up organisation of such a space.

One way streets

The good things about one-way streets seem to be that they increase flow. They also seem to be good at reducing walker/driver accidents. Zeeger argues that this is because they make crossing the road is simpler for the walker and the driver does not have to 'worry' about other traffic (Zeeger, 1993:193).

I have argued against flow earlier, saying that a city needs to value interaction rather than flow as a creator of the urban system.

One way streets not only over-privilege flow, they waste petrol when drivers have to loop around

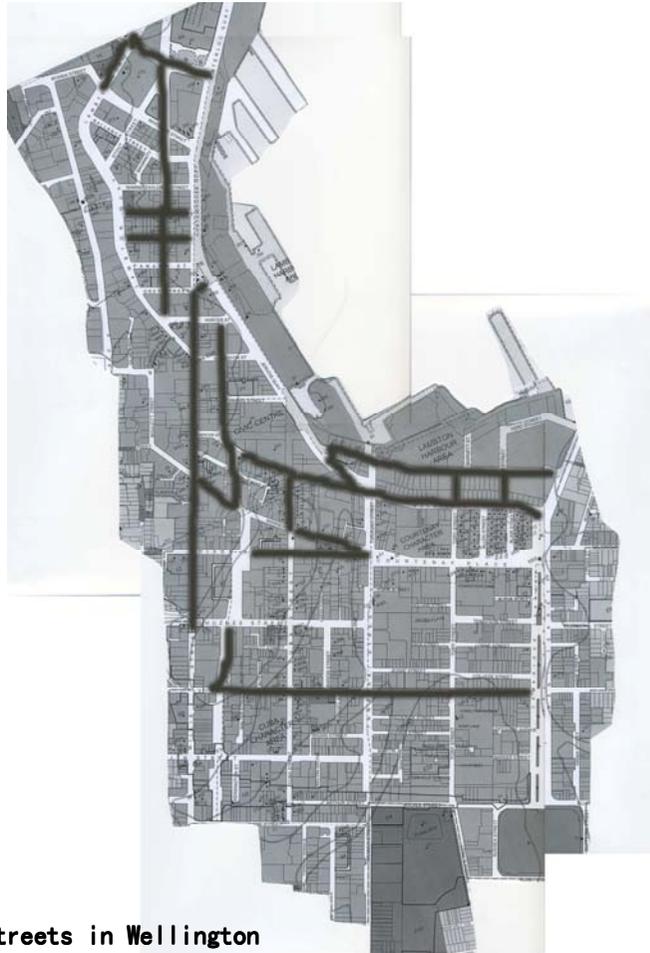


Figure 65 One way streets in Wellington

blocks to get to the desired end point. The driver now flows efficiently, but for twice the distance actually needed, and in my experience, when not completely familiar with every single road in the one-way system, in a state of incredible frustration and rage.

The connectivity of the city is affected negatively by the one way system.

Earlier research I did on Wellington indicated that one-way streets felt worse to be in than two way streets. Somehow the waves of traffic (all flowing very well) and the waves of emptiness felt as if they were draining the energy from the street (Reynolds & Wallis, 2006). I hypothesise that traffic in narrow, two way streets moves in a way that is more in tune with the body, more like the way we walk; weaving and dodging, slowing and speeding. In one-way streets the machine nature of car movement is emphasised. The morpho-ecology of the city responds to one way streets; in Wellington cafes and retailers avoid one-way streets in a negative feedback loop.

It would also be completely impractical to link a self-organising street to a one-way street. As I am of the conviction that in self-organised streets the ways drivers negotiate space has something in common with the way walkers negotiate space, I expect desire lines to be important organisers of movement for the driver. One-way streets kill desire lines.

One-way streets are an extreme manner of directing traffic in a top-down manner. It is hard to imagine streets self-organising to be one way. Drivers seem to be

able to negotiate even very narrow lanes as two way streets, even if they have to go incredibly slowly to do so.

An attempt to take the design down to street scale

Based on the jaywalking map, there were a couple of sites that would make good candidates for a self-organising street.

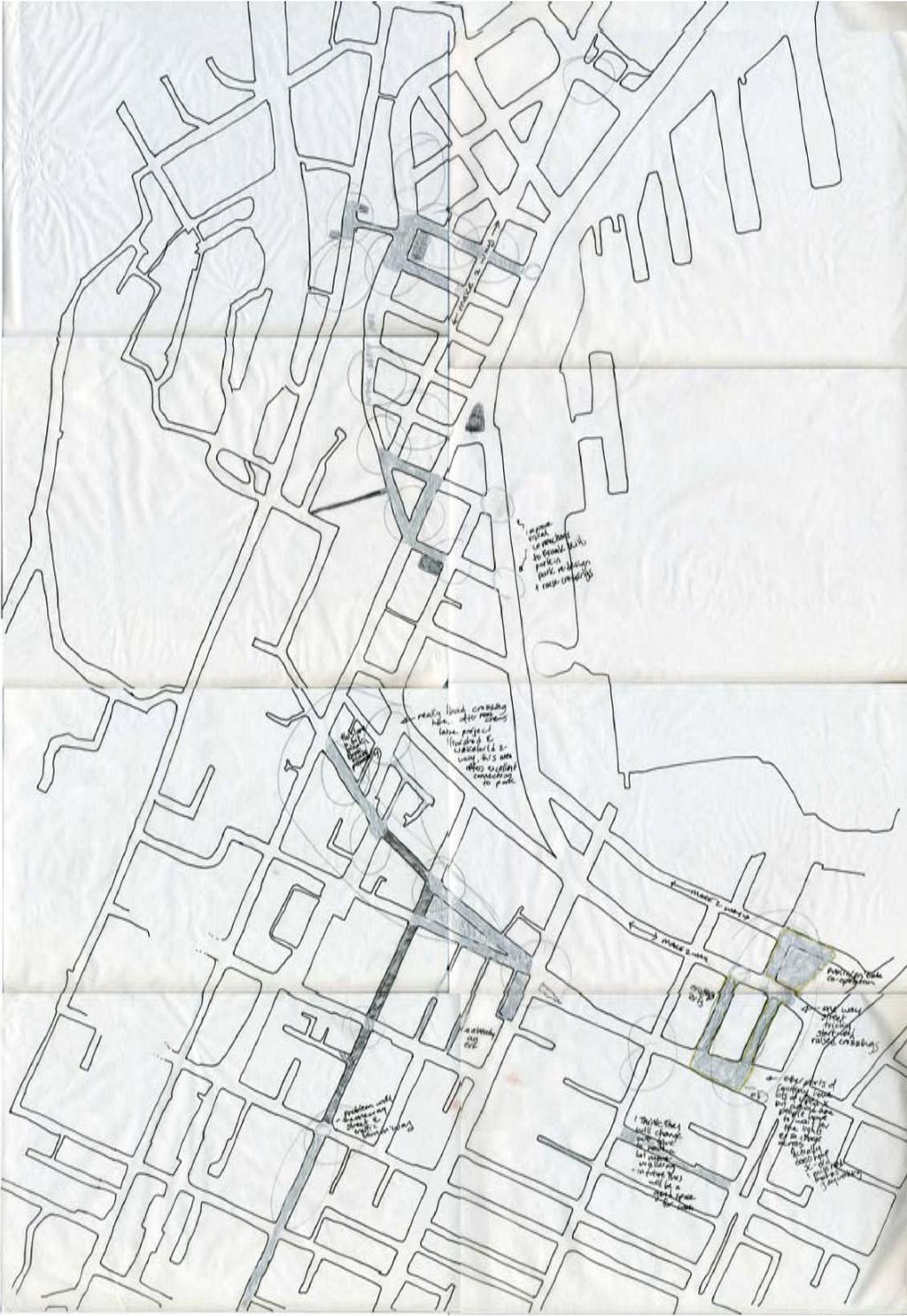
I chose the corner of Courteny Place and Taranaki Street, including Te Aro park.

I quickly ran into a key problem, one that I still have no solution for; essentially the relationship between process and formal design. Once the basic operations have been made that alter the process on the site have been performed: unifying grade, roughening the surface, removing traffic signs and signals – there was no clear rationale for choosing particular materials or forms. A nearly infinite number of combinations could accomplish the same changes in process.

I realised I could go on happily and design using materials and form I liked, or reach out to another theoretical basis to continue to develop the design, but I was committed to working with complexity theory.

I attended two lectures by landscape architects, whose research in the field of landscape processes, and who were still struggling to answer this question. If a number of forms can alter process in the desired way, how does the designer proceed in the form

Figure 66 site selection drawing based on jaywalking map



finding mission?

Julian Raxworthy said there were several projects he knew of where process was dealt with in a similar way, an intriguing and interesting way, but the forms used to create the change were completely different. He indicated he was not sure how to critique these differences from a process-centred perspective (Raxworthy, 2007b).

Ted Cooke, working with ecological design, said while he had no answer to the question of choosing one formal response over another, again from the perspective of process. He found he had to turn to other principles to choose the form (Cooke, 2007).

Although he didn't explore this further in the lecture, I think there was one clue in the grid of trees in a re-vegetation project, the type of project Cooke was dealing with. The growth of saplings and undergrowth would gradually disrupt the grid and this contrast between the ordering of the grid and the re-ordering enacted by the ecology would draw attention to and highlight the process of forest growth.

Yet a pseudo-natural clumped planting would declare in advance that the eco-system is valued and therefore a formal design inspiration.

I took the existing precedents and tried to abstract the processes employed.

Cobbles and tiles

Changing the surface from one that is smooth for driving to one that feeds back to the driver as rough, giving them the message to slow down seems to be fairly important. Cobblestones did this while simultaneously giving feed back that this was a 'people' space rather than a 'car' space.

I chose to extend this by using Ammann tiling. As this is a fractal tile pattern, it has a mathematical link to complexity; shapes and relationships that are complex tend towards fractal proportions.

This could be a tactic to introduce a collaborative design process. Tiles of various sizes could be programmatic elements and because of they are fractals, different sized elements could be interchanged and yet still fit together.

Collaborative design is a technique in line with complexity thinking. Complex systems are unknowable by a single agent in the system and therefore bringing different viewpoints together can mean problems of complex systems are understood in ways individuals cannot (Arias et al., 2000:84). Anne Whiston Spirn, Walter Hood and New Urbanists use interactive consultations or design charrettes in various ways to engage with

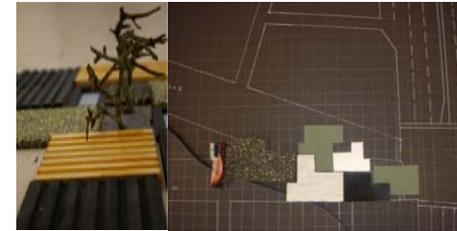


Figure 67 tiling/cobbling

collaborative design techniques.

The particular way I thought of engaging with group thinking would be to take a model of the site and a number of tiles with different programmatic elements to the site on a number of occasions and ask anyone interested to move/insert tiles where they would like to see them. Hopefully, the iterations and interactions of many people would result in the evolution of a design that dealt with the complexity of many stakeholders, many interests.

It was suggested that control of the resulting design could be a problem. Where was I as a designer in the final result? This method brought programming to the forefront of the design focus, but shared street design had *deprogramming* at its heart, and I felt this was a conflict of approaches.

There was a further non-trivial problem. How should one modularise the design process? Complex systems self-organise

into modules (Skyttner, 2005:100), but a top-down decision to modularise seems to often backfire when dealing with complex systems, the modulariser destroying some subtle communications in the process. I had created programmatic modules, but what about perceptual modules, any other modules?

Pouring

I was intrigued by Stadtlounge and derived two operations from this design; pouring and

blanketing. The intervention of colour was very powerful and gave intensity to the way in which surfaces are unified rather than divided in self-organised streets. The colour also made clear that the surface was *not* a road as we knew it. Tar seal is a grey colour but so many alternative materials used in shared street design are also grey; grey stone or grey concrete. They do not therefore scream "I am not a road" in the way Stadtlounge





does.

These are my photo-shopped interventions in Wellington. I found the effect of the change intriguing. Even the bright colours seem to introduce a sort of calmness to the space.

The operation of pouring makes visible the invisible; the traffic signing and the white lines, all the etceteras of the city that we don't normally see. When they are removed by the

operation pouring, we see them again because their absence has been so marked.

Figure 68 Hunter Street; dark red pour



Figure 69 Dixon St; Violet pour





Stadlounge introduces a textural change, a flocked surface that reads as carpet and/or playing field (Martinez, 2006). The designers' intention is to "uproot the idea of one 'correct' interpretation" (Martinez, 2006:28).

I kept imagining the designers as somehow dropping a blanket of this

Blanketing



soft textured material over the existing space.

This idea of blanketing had some appeal for the space. The Te Aro park design has a great deal of cultural significance woven into it and although there are ways in which it fails as a landscape design, it seemed arrogant and not necessarily appropriate to destroy it. Blanketing would allow the previous design to exist, to be re-interpreted. Some soft material, something like windbreak cloth would also respond to use, develop marks and flaws along self-organising trails.

Figure 70 Blanketing model

There is both a retrospective, traditional aspect to the shared street design, a returning to the past, and also a feeling of sweeping away of the mess of traffic orderings.

In this experiment, I think about the tracks, the traces of crossings wearing down layers on the site, working back to different layers of history; to the surface crossed by tram tracks, back to dirt roads of the nineteenth century, back to the Te Aro Pa and then to swamp land.

Walking/wearing

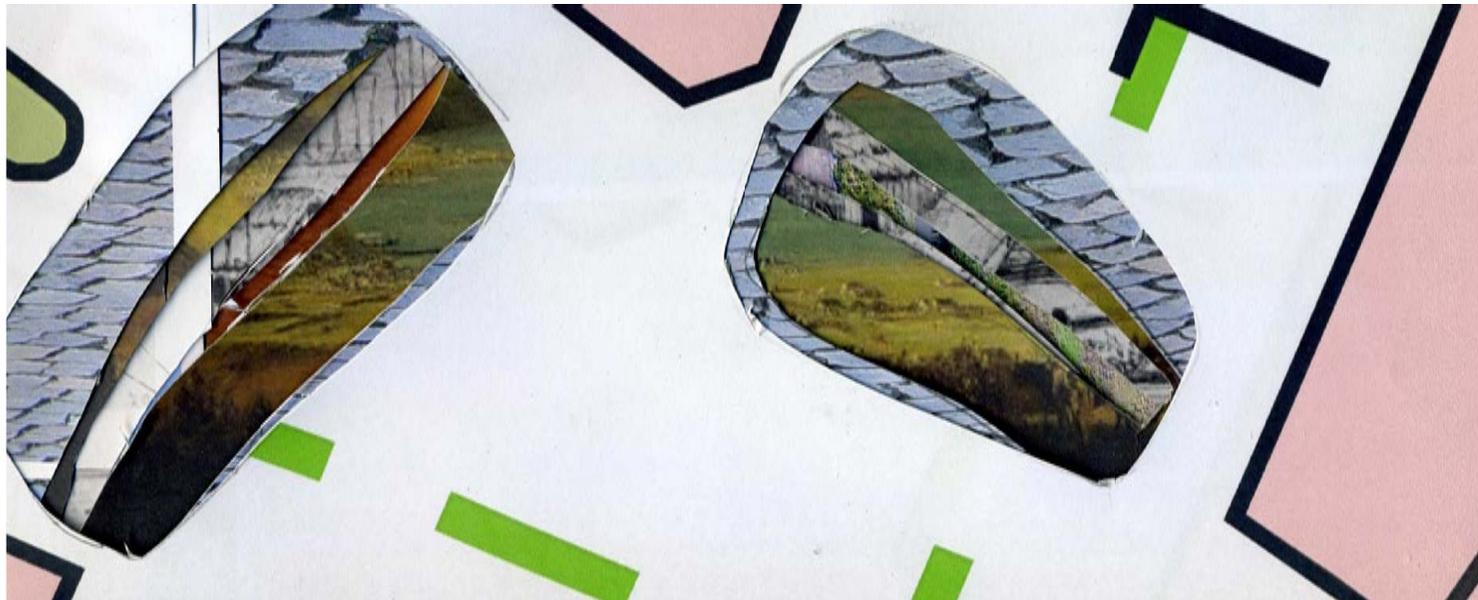


Figure 71

Wearing back design

At this stage, I knew I was without a rigorous method for advancing any design work, for rejecting one of these initial experiments and choosing another. Serious questions had arisen about design and the relationship between form and process. These are the questions I consider in the following conclusion.

The context of landscape architecture

Design disciplines that have traditionally emphasised form are now embracing process based design, termed 'fourth-order design' by industrial designer Richard Buchanan as follows: "...the design of organizations, environments and systems that serve the diverse purposes of human beings...they all employ an expanded concept of human interaction that is elevated from individual interactions, to collective interaction in complex environments" (Body, 2008: 57). The ongoing acknowledgement and focus on process in land-

scape architecture allows an exemplary base for design with complexity.

If the official history of landscape architecture starts with Frederick Law Olmsted, then the practice of designing to alter and manipulate process has always been part of that history. Olmsted's manipulation of the water processes of the Emerald Necklace is legendary.

This focus on process continues in the twentieth century as ecological design gains importance, with Halprin drawing a line connecting process and beauty, says "...not only does form equal process in nature, but I also think that we derive our sense of aesthetic from nature" (Halprin quoted in Jellicoe & Jellicoe, 1995: 333).

The latter part of the twentieth century saw a new interest in process design with the popular book *Radical Landscapes* saying "the phenomenon of continual change... growth, degeneration and chemical exchange and the effects of human behaviour over

time all coincide to shape the evolution of any given place” and names this as simultaneously the most intriguing and confounding aspect of designing in the landscape (Amidon, 2001: 80).

This interest in process seems to have thickened around the processes of water in the landscape, a very visible process in the landscape, the explication of which – in cascades, channels and the draining or recreating of wetlands – meshes easily with traditional ideas of what constitutes landscape design. But the physical and ecological processes on a site are not the only processes that create landscape. The various human processes of inhabitation are processes that are critical to an understanding of place.

As a type of process-based design in the landscape, the principles of gardening are worth considering here. Gardening is a way of working in the landscape that is dif-

ferent from landscape architecture. The ‘architecture’ in ‘landscape architecture’ is largely missing from the act of gardening. Instead of something being built, something is planted. This something, after being planted, must attempt to become part of the existing ecological system at the site. The gardener has not finished their work after planting; planting is only a minor part of gardening. Iterations of monitoring and tweaking create the garden: adjusting the flows of water or shade, pruning or trimming back anything that gets too rampant and threaten to overwhelm the rest of the system, weeding the undesirable, fertilising the desirable.

This understanding of the work of gardening is hardly foreign to landscape architecture, yet there is a continued challenge to fully incorporating the tactics of gardening into landscape architecture. These tactics are both hard to represent, and do not fit in with the typical design/build contract. Problems with assessment or judgement of design quality arise, too, with gardening. How is one to assess a project which will continually change, where initial design moves are regarded as just seeds?

Julian Raxworthy is the main proponent of a school of thought that could be called Gardenism and he questions how much landscape architecture is really responding to ideas of flux that gardening can accommodate and challenges the tools of representation (such as mapping) to adequately express the processes of gardenism (Raxworthy, 2003). Giles Clement is another gardenist, a landscape architect whose work focuses on the processes of plants 'in motion'.

If the tactics of gardening are applied to the site of the city, this becomes 'Urban Gardenism'. Iain Borden, in *Thirteen tactics for the good life* lists ways of working in the city that are iterative and temporal, equivalents of seeding, planting and fertilising (Borden, 2008).

Others who could be described as urban gardenists focus on the task of weeding. Recent articles research user response to the photogenic Dutch parks of the nineteen nine-

ties (Tisma & Jökövi, 2008, Lenzholer, 2008). They recommend responses to the problems of these urban parks that are analogous to weeding. They advocate removing street furniture that has either failed users or failed in the environmental conditions. This is not about flattening an area and starting from a blank site, rather a continual process of adjustment is preferred.

This research is a work of urban gardenism, suggesting design as a seed rather than an end and engaging in continual monitoring of sites and processes. The challenge in this approach is that, as in the garden, the built element can be fairly non-descript aesthetically and yet the system embedded in the space is a success. The garden is judged as much by how well the plants are flourishing, how well the system set up by the gardener is growing as much as it is by the formal success of the paths and fences. This is the same in urban gardenism. The city design will be judged a success (or not) based on the flourishing of the system that grows on the site as much as it is by the eye-catching effect of the formal aspect of the design.

Jan Gehl's work in Copenhagen (Gehl and Gemzoe, 2001) is an example of the long term work of an urban gardenist. Since 1962 Copenhagen's streets

have undergone a continuous process of pedestrianisation (planting) and car parks have been progressively reduced (weeding). Bicycle conditions have been improved and now free bicycles are available in the city (fertilising). In Gehl's descriptions of the process of change in Copenhagen it is notable that the processes, once initiated by the designer, have a tendency to continue on their own this is again similar to gardening; a gardener who weeds well for several years will find that new weeds do not seed. With

the ease of public transport and the low levels of parking spaces, few people now decide to drive in the city (Gehl & Gemzoe, 2001:51). The problem of new 'weeds' setting seed in the city does not arise.

Spanish landscape design office Ecosistema work as urban gardenists, looking to catalyse spaces rather seeking final solutions, and with a design they describe as a "superficial intervention" work to "it is the task of the architect to create the appropriate conditions for generating these processes of getting citizens involved in the process of creating, developing and improving public space. We have to create more flexible structures that can quickly respond to present day needs...if you create good new public spaces, cultural behaviour will adapt in accordance with it" (Bullivant, 2008:129).

The idea of gardening is an idea of working with a complex system in a way that moves towards design aims. It is accepted that the aims are never completely met, that a garden is never finished, and the gardener is never fully in control. Yet the tactics of gardening create spaces of great beauty, perhaps more beautiful because we realise the work is engaged with a powerful and complex system.

10

The high-flux principle Towards a conclusion

High-flux principle

When far-from-equilibrium, systems are forced to experiment and explore their space of possibilities and this exploration helps them discover and create new patterns of relationships.

(Skyttner, 2005:102)

...In complex systems theory the focus tends to be how the system / environment energy differential can be used by the system, not only to maintain itself in the face of external change, but also how it might (qualitatively) transform itself into quite a different system altogether--a question of evolution, not just maintenance.

(Richardson, 2004b:81-82)

This is not conservatism. This is not a reactionary suggestion; the resulting city is made up of connections and interactions that did not exist in previous centuries (internet, air travel, mobile phone connections...) so a thickening and densifying of geographic-based connections cannot take us back to some nostalgic state; rather the web of connections created by intermingling virtual and physical networks will create something new. Older cities, cities that have mineralised around historic processes, are cities with a strong infrastructure of interaction. This doesn't mean that a city with a strong infrastructure of interaction needs to be modelled on nostalgic design, nor does it mean that the way people behave will 'return' to some special state where neighbours all cared for one another...or any other nostalgic fantasy.

Results of interaction are powerful, but not under our complete control. Even so, they are necessary city infrastructure.

Some structure of interaction and feedback must be in place for emergent or self-organising behaviour to exist, and a responsive morpho-ecology must have this structure in place too. So in my search for ways to design with these properties of the city, I have focused on interactions, in particular, the interactions between drivers and walkers.

The infrastructure of interaction has been subsumed by the infrastructure of movement. This thesis is an argument to integrate the two infrastructures, removing aspects of the urban road structure that prevent

interaction. The spatial design of the shared street integrates – in fact requires – interaction and results in local order.

What would a city with a strong infrastructure of interaction be like? The ideas of complex interaction give few clues or answers for the questions of style. As Evans says of enfilades and corridors, this "customary way of joining rooms that hardly affected the style of architecture... but most certainly affected the style of life" (Evans, 1997b:65). Interpretations of the shared street, as

different as the woonerf of the seventies to Stadtlounge, work in the same way.

Stephen Johnson sees a city that has a sufficient density of interactions on the footpath as capable of self-organising in a way that places without these interactions can't (Johnson, 2001:90-94).

What might be deduced from theories of emergence and self-organisation is that cities with a strong infrastructure of interaction would be learning and evolving in response to the people inhabiting them and in response to the material and cultural environment.

Johnson and Jane Jacobs (Johnson, 2001, Jacobs, 1961) argue that a city with an infrastructure of interaction, as better connected self-organising system, will be able to maximise economic opportunities. For the designer, it is as interesting that this city with a strong infrastructure of interaction could also maximise social and cultural opportuni-

ties.

The street is not the only space to provide an infrastructure of interaction. Markman Ellis makes the argument that coffee changes the way we interact (2004:24). The coffee house as place of interaction in English catalysed not only political and cultural development, but also the stock market (Ellis, 2004). The changes he associates with the interactions created by the coffee-houses have the nature of cultural phase changes; democratisation, the enlightenment and the stock market. Elizabeth Currid makes a similar argument; that the intense club and restaurant scene of New York (2007:4), as well as the density and walkability of the city (2007:8) - provided interaction opportunities, catalysing twentieth century artistic development and economic benefit. Again, twentieth century change in art centred in New York can be understood as culturally catalytic.

The concept of an infrastructure of interaction can be used to encompass other current ideas of urban design. Permeable boundaries and mixed can be described as part of the infrastructure of interaction. Narrow city streets allow for a greater degree of interactions, between the people and the fabric of the city, on both sides

of the street instead of only one as on wide, heavily trafficked city streets. Further research on the concept of an infrastructure of interaction is likely to continue to find interesting results for urban design.

Linear reasoning applied to complex systems can produce unexpected effects – effects that are perhaps the opposite of what was intended. Rem Koolhaas talks about Junkspace, about modernization creating Junkspace by coagulation (Koolhaas, 2004). The modernist concept of tidying and ordering space *produced* rather than eliminated a junked space : “Although its individual parts are the outcome of brilliant inventions, lucidly planned by human intelligence, boosted by infinite computation, their sum spells the end of Enlightenment” (Koolhaas 2004:162). The vision of all space everywhere as having an articulated, planned purpose created space with inarticulable purpose.

Designing for smooth flow creates junk movement

The parallel modernist vision of having movement everywhere smoothly coordinated and articulated has lead to junk movement – junk driving through the jammed city, halted, switching from neutral to first to second gear and then back to neutral again (hardly the best use of the internal combustion engine and a tonne of metal) or a way of walking that could be called junk walking, stopped by the Red Man, herded into narrow footpaths. The desire lines of the city are cut by traffic and a manifold of movement space is reduced to a graph

The place of the urban has been made ‘dumb’ or to use Sennet’s term, ‘catatonic’ (Sennett, 1994:14) by treating the street (a word that contains meanings of neighbourhood, environment and opportunity) as

merely a thoroughfare or artery. Cars and driving can be blamed for this, but it is adjusting city space as if driving a car is *the* tool of being in the city, and moving as quickly and efficiently through and over space is the point of moving, even the point of space.

Le Corbusier said one of the four basic principles of city planning is that “We must increase the means of getting about” (Le Corbusier, 1929:170). The urgency and directive structure of this sentence echoes the directive thrust of Le Corbusier’s vision of the

power of the car. It seems so important to traverse space, so very urgent. Yet traveling through it is only one function of space. Devoting space entirely to fast travel is a denial of that space as place. Under this mandate of speed, space now exists only as a hindrance, something that only prevents one from reaching the goal of being somewhere else.

Just as Evans concludes in the following passage that the effect of architecture as like a lobotomy in the following passage, the effect of traffic engineering has created Sennet's 'catatonic space':

The cumulative effect of architecture during the last two centuries

has been like that of a general lobotomy performed on society at large, obliterating vast areas of social experience. ... [architecture] limits the horizon of experience – reducing noise-transmission, differentiating movement patterns, suppressing smells, stemming vandalism, cutting down on the accumulation of dirt, impeding the spread of disease...there is surely another kind of architecture that would give full play to the things that have been so carefully masked by its anti-type; an architecture arising out of the deep fascination that recognizes passion, carnality and sociality. The matrix of connected rooms might well be an integral feature of such buildings. (Evans, 1997b:89-90)

Just as there is another kind of architecture,
there is another kind of street design.

If place is understood to be “constructed
out of particular constellation of relations articulated together at a particular locus” (Massey cited in Larsen, 2006:14), then those whose design practice is place making need to pay close attention to and foster this delicate network of relations.

If the old emergent space is catatonic space, what is the new space? Is this intelligent space?

...all I need is a brief glimpse, an opening in the middle of an incongruous landscape, a glint of lights on the fog, the dialogue of two passersby meeting in the crowd, and I think that, setting out from there, I will put together, piece by piece, the perfect city, made of fragments mixed with the rest, of instants separated by intervals, of signals one sends out, not knowing who receives them. (Calvino, 1974:126)

The city is built of fragments, fragments of both space and time and information. From these pieces these fragments, the city emerges.

This way of designing can be seen as *allowing* rather than instructive and determining. It allows the use of the street, the individual’s experience of the street, and allows the city to be created through process.

Paradoxically, designing for movement means designing to allow stillness.

The opposite of designing for speed is to design for slowness. The shared street is

arguably designing for slowness. The counter-intuitive result is that a certain speed of movement can be achieved more easily here than in the space designed solely for movement. The speed limit is dropped, the surface roughened, the material accoutrements of parks (those parts of the city designated and reserved for stillness and slowness) – trees, seats, art, plantings - are added to the street. Hamilton-Baillie's belief that there should be something solid, some sort of anchoring device in the centre (Hamilton-Baillie, 2004) emphasises stillness and slowness, rather than speed.

Monderman believes that perceptions of time alter for the driver in the shared street as they are part of a social world here, and the quality of the experience alters time perception (Engwicht, 2005:55).

Flowing is not an aim in itself – just moving for

the sake of movement is only a small part the city. The aim of flow is interchange, exchange of some kind. In fact, having more exchange with less flow can be a benefit; less energy is consumed in the flow, less infrastructure required to be built or perhaps more exchange for the same effort.

For the city as a whole, as a complex system, slowness maybe desirable. An argument has been made for the importance of slow strategies for complex systems : "...a 'slow' strategy is not a

backward-looking one. If a somewhat slower tempo allows a system to develop a richer and more reflective memory, it will allow the system to deal with surprises in its environment in a better way" (Cilliers, 2006:109). This is the time relaxation principle at work in the city.

The most interesting and engaging public spaces are those that connect us to the most fundamental paradoxes in our minds: the clash between our need for order and our need for spontaneity; our need to move and our need to stay still; our need for solitude and our need for intimacy; our need to be known and our need to be anonymous... In these spaces we are forced to pause and dance with the impossible for a moment. (Engwicht, 2005:74-75)

Enfilade

A

change from engineered space to an integrated landscape space is the shared street like the emerald necklace project, integrating infrastructure and simultaneously converting the space from some type of unitary function. The shared street can also integrate some of the functions of 'park' (places devoted to relaxation and extended socialisation, places for trees and benches) into the street space, instead of having the park segregated and separate from the body of the city. This segregation and separation again diminishes the urban experience.

Integrating different functions into a design appears to create the emergence of something more complete, something more than the sum of the parts.

Now the two functions are no longer distinguishable; a unique structure has thus evolved, one which is not a compromise but a concomitance, a convergence...The bivalent

fin/rib structure therefore fulfils the two formerly separate functions by means of a synthesis - and the result is far more satisfactory in both cases: it integrates the two functions and transcends them.

(Baudrillard, 1996:6)

In other words, integrating functions can result in the classic emergent property, where the whole is greater than the sum of the parts. As Baudrillard goes

on to say “Every transition from a system to another, better-integrated system, every communication within an already structured system every functional synthesis, precipitates the emergence of a meaning...” (Baudrillard, 1996:7).

Landscape not engineering

Landscape urbanism claims the city as landscape. It is the field in which we live. Landscape architecture seeks to celebrate the processes that work in the field of operations, but in the urban what are the natural processes, how do we separate them from the city processes? The point of landscape urbanism is that we don't. Moving in the urban environment is one of these processes.

Like rivers, these flows of movement have been treated as engineering problems only, regarded as dealing with functions rather than as spatial design, with impact on how people respond to space around them. The apparatus of traffic engineering is almost regarded as invisible, as something we barely see.

Kathy Poole brings an understanding of the infrastructure of the city as an ecology rather than a machine, into the discussion of landscape architecture. Poole calls for ecological networks to be exposed and integrated into the city networks, to allow richer readings of these infrastructures than

are displayed when the infrastructures are 'engineered' rather than 'designed'. She says “The public came to view the 'progress' of the city's infrastructure through the standardization of physical environments. Like the bureaucracy of experts that designed them, the common structures were judged primarily on technical criteria rather than on social or aesthetic expectations” (Poole, 1998:120).

Movement is an aesthetic practice, a place creating practice

De Certeau talks of space as something that is created by our movements, our tactics of use. If our ways of moving in the city have been at times turned into junk-movement, then this has implications for spatial processes. Urry says the way we move is a continual process of making and remaking our cultural identity and social lives (Urry, 2000:49) – if this is so, a richness of movement experience is worth seeking over junk-movement.

Reading *Walking in the city* with a knowledge of complexity reveals de Certeau insightful understanding of how the city and how space work

Spatial practice as emergent

as complex systems. It starts with de C talking about taking the lift up the World Trade Centre and looking down on the rest of New York (1984:91). The people below de Certeau are seen as a “mass that carries off and mixes up in itself any identity of authors and spectators” (1984:92). This reads as a description of a complex adaptive system, where the urban masses are part of a type of entity in which the agents are like cells, ants or neurons – parts of the whole, parts of the city. We cannot be completely outside the system, spectators of it, unless we take the lift with de Certeau. It is only the large number of actors (writing their own insignificant parts) and the many iterations that comprise the city. De Certeau says the walkers are making “an urban ‘text’ they write without being able to read it.” (1984:93).

So many of our intellectual devices are about striving to see patterns *outside* the system (for example, history and sociology

attempt to find patterns in society) In complexity theory, those within the system - the agents – don't have global awareness of the patterns of the system (Casti, 1994:19). But these devices to rise above the system's interior, to find an unattainable objectivity are devices that ants and neurons do not have access to. These devices must work like balloons we let off from the midst of our complex system to get glimpses of the patterns that can be seen only completely by something truly outside the system. Maybe lifts, too, are one

of these devices; a device to see the city as a pattern created without individual authors and spectators.

"The networks of these moving, intersecting writings compose a manifold story that has neither author nor spectator, shaped out of fragments of trajectories and alterations of spaces..." (1984:93). This is a clear description of an emergent story, something created from a network of interacting fragments.

De Certeau critiques the 'Concept-city', created by 'rational organization'. This Concept-city is constructed by properties that are conceived of as being 'isolatable' and 'finite'; a description of reductionist way of organising the city. The results of treating the city in this way, as a concept-city, are the counter-intuitive effects of complex systems, it "repeatedly produces effects contrary to those at which it aims" (1984:95).

This reductionist city organization "by privileging progress (i.e. time), causes the

condition of its own possibility – space itself – to be forgotten; space thus becomes a blind spot in a scientific and political technology.”(1984:95). I interpret this as de Certeau understanding space as an emergent property, produced by the interactions within the complex system, and invisible to the reductionist way of analysing the city, as emergent properties have traditionally been to reductionist analyses.

Complex systems are unable to be organized in a top-down manner. De Certeau records the failure of this attempt to organize the Concept-city with a reductionist approach, the city stubbornly refuses to *be* organised and instead organises itself. The city is left to “contradictory movements that counter-balance and combine themselves outside the reach of panoptic power.” (1984:95).

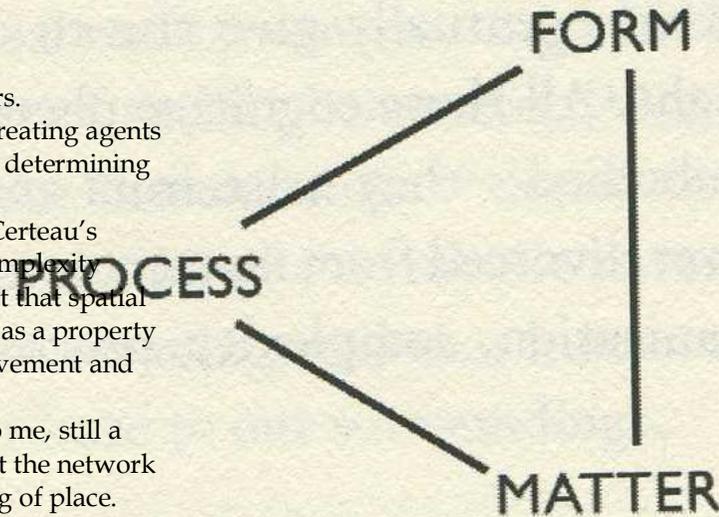
De Certeau recommends another path, where one looks at the agents of the system, a bottom-up programme appropriate to complex systems. We should “analyze the microbe-like, singular and plural practices...one can follow the swarming activity of these procedures that ...have reinforced themselves into the networks of surveillance, and combined in accord with unreadable but stable tactics to the point of constituting everyday regulation and surreptitious creativities...” (1984:96). It seems, from this discussion, as if spatial practices are a combination of the agent and the processes engaged in by the agent. The “unreadable but stable tactics” that combine and reinforce themselves must surely be stable attractor states and the sur-

repetitious creativities emergent behaviours.

Spatial practices are the structure creating agents of the system; they “secretly structure the determining conditions of social life” (1984:96).

I would love to continue this – de Certeau’s traces and borders all have parallels in complexity thinking, but the aim of this is to point out that spatial practices can be understood as emergent, as a property arising from the interactions between movement and space.

In some way that is still not clear to me, still a blind probing of the fitness landscape that the network of ideas inhabits: this is about the meaning of place.



Meaning

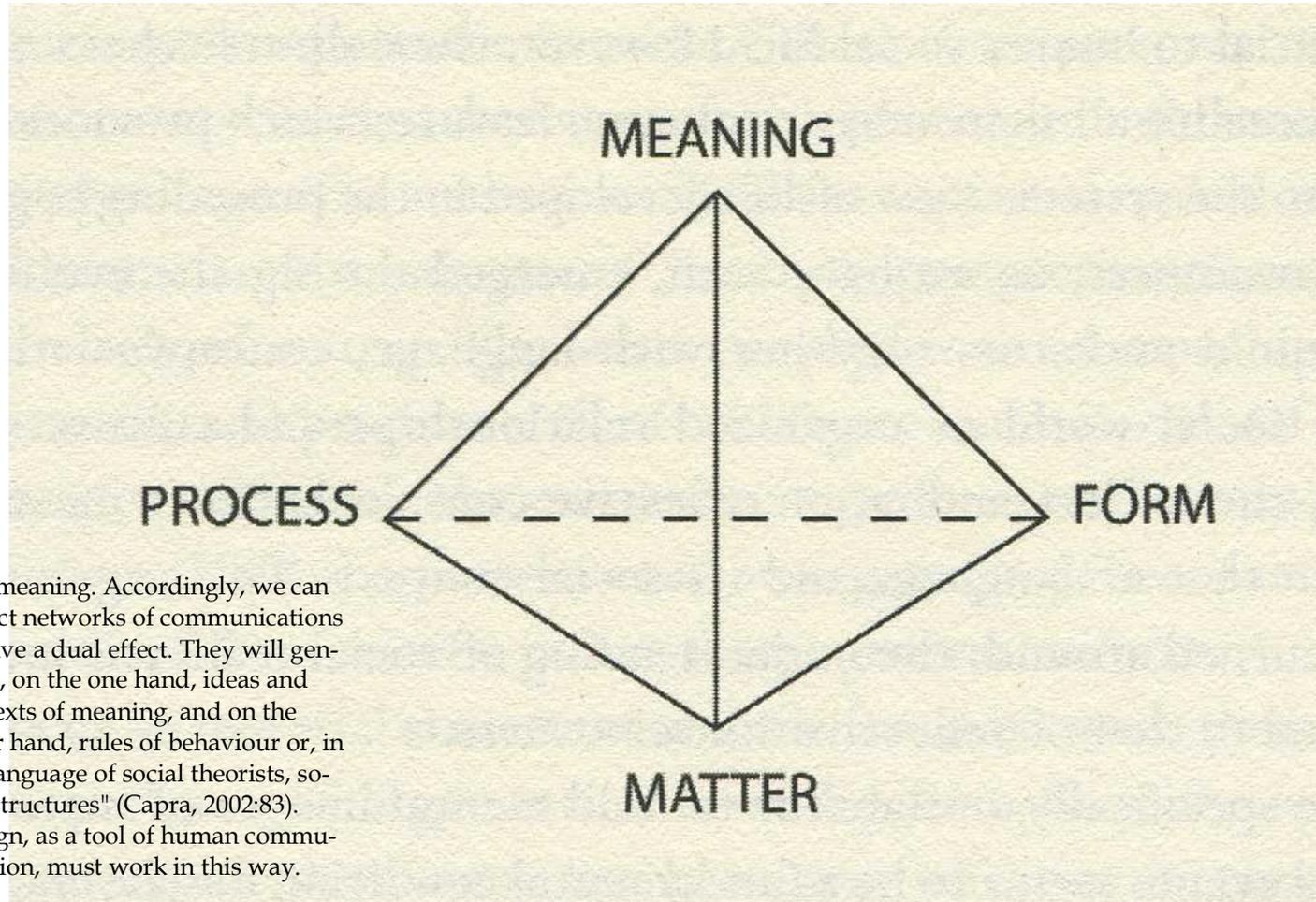
We seem to somehow induce meaning from emergent patterns. Some sort of character emerges from the interaction between form and process.

Fritjof Capra says we derive meaning from the interaction between form, matter and process (2002:71-74).

Meaning is both created and expressed by this system. Human communication, Capra says, "...involves a continual coordination of behaviour, and because it involves conceptual thinking and symbolic language it also generates mental images, thoughts,

Figures 72 & 73

Fritjof Capra



Abstracting a form from the context of its functioning is to render this object/form meaningless. TRACES things abstracted from their system and so refer to an 'absence' rather than the act itself and "[t]hey allow us to grasp only a relic set in the nowhen of a surface of projection" (1984:97).

"A city sidewalk by itself is nothing. It is an abstraction" (Jacobs, 1961:29).

Function, the structuring of processes, is not a separable thinking, but is a co-creator of

both form (as a morpho-ecology) and a co-creator of meaning.

Form, isolated from process is meaningless, and so is function isolated from considerations of form. When the focus of street-scape is functioning alone- the reductionism of traffic engineering - we are avoiding the creation of not only something necessary for city-wide functioning, an infrastructure of interaction, but we are also avoiding the creation of meaningful street space.

Baudrillard talks about the abstract form in same way from other end.

"The technical object may thus be said to have a primitive form, an abstract form, in which each theoretical and material unit is treated as an absolute needing to be set up as a closed system if it is to function properly" (Baudrillard, 1996:6).

And so, in the way of complex systems, systems that create convoluted loops, we are at the beginning of a new cycle of research. If the meaning of a space is an emergent

property of the interactions between form and process, we have some of the same questions. What is the nature of the agents involved? What are these interactions exactly and how are they structured? What are the feedback devices? What has long term observation revealed? Are there any counter-intuitive results, or phase changes, or power laws, the hallmarks of complexity at work?

The research discussed in this document changes the convoluted fitness landscape of design theory to a slight degree. I have created connections between shared streets and self-organisation, between traffic planning/engineering and reductionism. I have furthered connections between urban design and ecological design. I have tightened connections between complexity theory and significant design theoreticians.

For these sites in the fitness landscape of ideas, the topography is raised by some small measure, finding zones for further probing, and raising the overall fitness peak of complexity as a theoretical basis for design.

Conclusion

Designing space means affecting interactions.
Affecting interactions means altering complex systems.

Spatial design orders movement, movement that creates spaces, creates openings and boundaries. The movement mode again alters interactions. Walking is a public act with high degrees of interaction and communication. Car driving creates a profoundly private space within the public realm of the street. Being encased within the material body of the car body itself deprives the city of interactions; the implementation and operation of traffic engineering works to further relieve the city of interactions.

These interactions, the interactions made while moving, are restructured by the shared street. Interactions that were subsumed into the system of traffic engineering are now, in the shared street, made directly with other agents, other people in the city.

The 'responsive' aspect of movement design does not have to be designed or constructed into the fabric of the system, or constantly managed, it needs to be allowed. Opening the boundary of the kerb allows the agents operating within the system to make the small scale adjustments themselves that will ensure the whole system is responsive.

There is a possibility of the whole city becoming more responsive, alert. I have some trouble with the word 'alive' used in this context. There are too many imprecise implications and the term has become over-used within certain urban design discussions. But there way 'alive' seems to find an easy currency in the discourse on the city spaces implies there is some quality this word has power to allude to. If meaning is created, as Capra suggests, through the interactions between form, matter and process

(Capra, 2002:117), then the meaning of a city can be found not only through the form and matter of the urban environment, but in the integration of urban processes within this form. The shared street is an example of a city space that integrates form and process to an unusual degree, and is therefore a great potential creator of meaningful cities.

This research shows street space can work without the hierarchy that has come to be regarded as normal, of driver above walker.

This research is also important because it gives an explanation of the mechanism of shared streets working that is part of the rational world, not just the political or aesthetic because for shared streets to become acceptable to traffic engineering, there must be a rational explanation.

The knotting of infrastructures, the thickening of flows within a city makes it a complex system. Complex systems have a reciprocity between process and 'mineralization'. The system evolves as a whole, with form and process inseparable. This makes it an illusory task to design only with form. Without an understanding of the process the form may alter the associated processes in unexpected ways. Similarly the processes may in turn alter the form in unexpected ways.

Among the many networks of flows that go into making the city, the network of encounters, of meetingness, is a network that is underestimated and underrated.

Designing the infrastructure for this network of encounter is a vital aspect of urban spatial design. The public space of cities is a space that enables both ordered and random encounters. This mixture of a random and

ordered structure appears to be the most efficient structure for information to flow through a network. This knowledge confirms the importance of urban spatial design as a means of facilitating encounter and meetingness. The city-wide implications are unknowable at this point, but allow the possibility of a more 'intelligent' city.

A further confirmation of the argument that cities must be treated as complex systems rather than as simple systems that are amenable to linear and re-

ductionist thought is the failure of modernist city design. Reductionist analyses were (and are) applied not only to the city as a whole, but to a city sub-system: the road. The urban traffic system is now often regarded as a complex system with evidence of emergent behaviour (traffic jams) widely cited in popular books on complexity (Gleick, 1987, Buchanan, 2001). I find the mis-amplification and dampening of the feedback loops in the evolution of the traffic/road system particularly disturbing, with the benefits to industry and the military given more importance than the monetary and pollution costs to the public and reinforced the existing social hierarchy.

Of particular relevance to landscape architecture is the fact that consideration of the impact on urban quality of road making decisions was also overlooked in favour of vehicle flow. The effect of road modularisation was to divide urban space into the spaces designated solely for formal qualities (i.e. parks) and spaces designed solely for the process of driving, the carriageway and footpaths. These footpaths may be decorated by landscape architects, but the shapes of these spaces concerned can currently only be defined by traffic engineers.

The development of the shared street demonstrates an alternative to the historic modularisation and reduction of the urban landscape. The effectiveness of the shared street cannot be predicted by reductionist logic. However, an analysis of the movement modes reveals that the combination of the car body and traffic engineering work to reduce the many small interactions that

are made while walking. Arguably it is these many tiny interactions that allow us to move smoothly in crowded walking situations; to self-organise. In the shared street, the spatial design necessitates user interaction. As a consequence, movement in *all* modes seems to work in a way that could equally be described as self-organising.

This is a fascinating example of spatial design helping to effect emergent behaviour, and effect it in an especially productive way. This is also a way of designing that argues for the entire

urban surface to have potential as 'landscape' rather than 'roadscape'.

The sense of wholeness in these designs points to another (potential/possible/indicative) result. The interaction between process and form in space is itself capable of emergent behaviour, behaviour that can be interpreted and understood by the viewer as an aesthetic completeness that is not present in the isolated parts of and that only an interaction between form and process can create.

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