UNIVERSITY OF SOUTHAMPTON

FACULTY OF HUMANITIES

School of English

Poetry on the Edge of Chaos:

The 'Ecosystem' and the 'Ecotext'

by

Rosalind Sarah Rachel Ambler-Alderman

Thesis for the degree of Doctor of Philosophy

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'I think the next century will be the century of complexity.'

Professor Stephen Hawking

San Jose Mercury News
Morning Final Edition, January 23 (2000).

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ABSTRACT

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Avant garde poetry in America and Britain in the later 20th century can be read as an index of cultural and scientific change, recording how notions that inform or derive from the 'ecosystem' concept, from the superorganism to systems science to complexity theory, acquired traction in both literary and other discourses. It also records the stirrings of ecological fear in the aftermath of conflict. By virtue of its countercultural positioning and innovative practices, this poetry was in a position to interrogate the dominant cultural models and orthodox science of its time, to envision new possibilities for engaging with the environment, and to enter into ecological debates. Poets such as Louis Zukofsky and T.S. Eliot engaged in a reciprocal dynamic of influence with systems scientists, such as Norbert Wiener and R. Buckminster Fuller, whilst Gary Snyder substantively engaged with the work of the ecologist Eugene Odum. The Language writer Lyn Hejinian has created an instructive synthesis of ecological ideas and philosophy in her work. Contemporary poets such as Juliana Spahr, Marcella Durand and the British poet Colin Simms continue, directly or indirectly, to interrogate scientific models in their poetry.

This thesis will explore the epistemic transmission of the 'ecosystem', a key ecological concept richly loaded with metaphor and myth, and will use it to explore the connections and disparities between how we think of biological systems and how we think of ecopoetry. In a hybrid approach, *Poetry on the Edge of Chaos* will consider how poets have engaged directly with the problematic history of the 'ecosystem', and will also question the validity of the ecocritical convention of comparing poems and ecosystems. It will consider whether, beyond analogy, there is a true homology here because both textual and biological systems are complex systems, and, if so, what this might tell us about how we read environments and how we read texts. This thesis will consider whether a cross-domain mapping presaged upon complex texts and complex ecologies sheds light upon texts, ecosystems or scientific paradigms, and extends our reasoning in either discourse. In so doing *Poetry on the Edge of Chaos* will seek to suggest ways in which, alongside the work of the sciences, writing, reading, and studying poetry continue to be relevant in an age of ecological uncertainty.

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DECLARATION OF AUTHORSHIP

I, Rosalind Sarah Rachel Ambler-Alderman, declare that the thesis entitled

Poetry on the Edge of Chaos: The 'Ecosystem' and the 'Ecotext'

and the work presented in it are my own and have been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;

2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;

5. I have acknowledged all main sources of help;

6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

7. Parts of this work have been published before submission as '"A Poetry of Observed Relationship": Observation, Objectivity and Creaturely (Inter-)Subjectivity in the Radical Landscape Poetry of Colin Simms', Anglistik International Journal of English Studies (Special Issue: Focus on Animal Poetics), 27 February 2016, pp. 111-124.

Signed:

Date: 8 September 2017

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INTRODUCTION

In Defence of Ecopoetry

> 'Poets are the hierophants of an unapprehended inspiration; the mirrors of the gigantic shadows which futurity casts upon the present; the words which express what they understand not; the trumpets which sing to battle, and feel not what they inspire; the influence which is moved not, but moves. Poets are the unacknowledged legislators of the world.'

Percy Shelley, *A Defence of Poetry*[1]

> 'There seems then to be no place where the cultures meet. I am not going to waste time saying that this is a pity. It is much worse than that. [...] But at the heart of thought and creation we are letting some of our best chances go by default. The clashing point of two subjects, two disciplines, two cultures – of two galaxies, so far as that goes – ought to produce creative chances. In the history of mental activity that has been where some of the break-throughs came. The chances are there now. But they are there, as it were, in a vacuum, because those in the two cultures can't talk to each other. It is bizarre how very little of 20th-century science has been assimilated into 20th-century art. Now and then one used to find poets conscientiously using scientific expressions, and getting them wrong—there was a time when 'refraction' kept cropping up in verse in a mystifying fashion, and when 'polarised light' was used as though writers were under the illusion that it was a specially admirable kind of light.
>
> Of course, that isn't the way that science could be any good to art. It has got to be assimilated along with, and as part and parcel of, the whole of our mental experience, and used as naturally as the rest.'

C.P. Snow, *The Two Cultures*[2]

1. Poetry and Science

C. P. Snow's Rede Lecture of 1959 famously outlined the problems he identified with the polarisation of the humanities and the sciences, and the consequent formation of a 'dangerous gap between science and literature', to surprisingly controversial effect. Whether or not Snow's criticism of the educational system in the United Kingdom was deserved at the time he made it, and, if so, whether this division continues to the same degree, is still

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1 Percy Bysshe Shelley, 'A Defence of Poetry', (Bartleby, 1840), paragraph 48 <http://www.bartleby.com/27/23.html> [Accessed 14 April 2016].

2 C.P. Snow, *The Two Cultures and the Scientific Revolution* (UK, University of Cambridge Press, 1959), p.9.

being debated more than half a century later. On the one hand, the idea that science and literature are radically different and even opposing modes of knowledge persists, as does the contention that each has a distinctly different focus, and in funding terms very different degrees of value continue to be ascribed to each of these areas. On the other hand, it seems problematic to insist upon a categorical separation; both science and literature are informed by and inform a common episteme, and there are numerous examples of cross-disciplinary traffic between them. Recently an overtly interdisciplinary research agenda has become fashionable, but it is questionable how far genuine convergence has so far been – or can be – achieved, given the tendency towards specialised knowledge in each of these fields and the consequent difficulty that the two cultures, as Snow puts it, 'can't talk to each other.'

Yet in view of our unprecedented ecological predicament, the problem of bringing together these discourses as fully as possible should press itself more urgently upon our attention. Ecologists and climate scientists warn of a substantial, accelerating global loss of biodiversity, and of the destabilisation of the natural systems upon which we depend. Some have detected an existential threat arising from the increasingly unpredictable patterns of the Earth's climatic systems. Even if this threat has been overstated, which at this time we do not know, there is no doubt that the current loss of biodiversity will leave us significantly the poorer, in economic as well as in aesthetic and affective terms. Of course, that is to phrase the problem from an anthropocentric perspective; there are also considerable ethical reasons as to why we should now all work to understand the ecological crisis and – if possible – reverse or at least contain it. We need to bring all of our intellectual resources and perspectives to bear upon this problem. But what can the arts and humanities bring to the study and understanding of the Earth's systems, alongside the sciences? How and where might texts and ecologies intersect? What, more specifically, can ecopoetry bring to the ecological debate?

It might appear unlikely that any solutions to climate change could lie within poetic texts or within even the most sustained and rigorous ecocritical analysis, particularly in view of poetry's niche status. Although the importance of poetry has been extensively discussed and defended over the years, it is nevertheless difficult to make a case for the direct application of poetry to the physical world, and therefore difficult – at least at first sight – to make a case for its significance in ecological terms. The classic answers to the questions I have posed about the role of poetry tend to be expressed in terms of the aesthetic or the political. That is, poetry aestheticises our experience of the living Earth or explores our affective response to ecological uncertainty, or, in the case of the sort of ecopoetry that explicitly

foregrounds environmentalist pieties, it takes an ideological and instrumentalist approach. According to the critic Robert von Hallberg, poems 'are not meant to extend ordinary discourse; a poem's triumph rather silences discourse.'[3] Von Hallberg is concerned with the power and authority of poetry, which silences discourse, rather than what a poem may conceptualise or what enlightenment it may bring: the most distinctive authority of lyric, in his view, rests on its affirmative function, compared with the intellectual disciplines that derive from doubt.[4] Finally, he admits that 'poetry yields knowledge, but this claim remains in the background because it is so grand.'[5]

I want to suggest that poetry can go further than the aesthetic or political or affirmative, to argue that perhaps the two cultures are not so very distant after all: that is, poetry can think as well as feel. Poetry is an important alternative means of engagement with the materials and objects of science that can interrogate even as it theorises. Poetry does matter, in practical terms as well as theoretical ones, and so does the work of analysing poetry within its wider cultural and historical context. This thesis will seek to suggest ways in which, alongside the work of the sciences, writing, reading, and studying poetry continue to be relevant in an age of ecological uncertainty. If we are to tackle ongoing ecological damage to the Earth, we must first understand its living and non-living systems. Yet ecological science faces some significant difficulties in managing and predicting – or even observing – change on a global scale. How can we model the Earth's dynamic processes? How can we overcome our limitations of perspective in terms of spatial scale and geological time? In the absence of universal ecological 'laws', can we identify workable principles to advance our understanding of complex biological systems? These problems are not new. From the very inception of ecology, issues of scale, complexity, visibility, randomness, and feedback, among others, have challenged its practitioners, problems that have been complicated by how ecologists have sought to address them. It is here, perhaps, that poetry and ecocriticism might be able to assist, by interrogating both ecological complexity itself and the problems of scientific representation. After all, texts and ecologies are informed by common ontological and epistemological dynamics. Language and ecology also share some of those problems that present in modelling or predicting the operation of complex or unstable systems: the necessary emphasis on the local, the invisible, the emergent, and the self-organising, and the fact that we are always inside the system we are attempting to study. Poetry, in theory, can offer a useful perspective both on the Earth's systems and on how we

[3] Robert von Hallberg *Lyric Powers* (Chicago and London: University of Chicago Press, 2008), pp. 4-5.
[4] Von Hallberg, p.10.
[5] Von Hallberg, p.105.

experience, read, and represent those systems. Moreover, science and poetry offer some complementary and reciprocal hermeneutic tools to one another: studying ecological poetry can reveal the hidden dynamics of the language and constructs that we use to describe biological systems, and an interpretative appraisal from this perspective might illuminate something about the substantive, formal and structural properties of experimental texts.

The extensive history of engagement by poets with the natural world has been well documented and continues to generate a steadily growing body of criticism. That history is important, but there is a less well-studied but illuminating history that also needs to be conducted in conjunction with it: that is, how poets and critics have engaged with the emerging ideas of ecological science over the last hundred years, and, more broadly, what the sources and impacts of these ideas were. In this thesis I will seek to document the cross-cultural movement of ecological ideas, with a particular focus on the example of the 'ecosystem', a central concept of ecology, and how these ideas are themselves informed by interdisciplinary currents and a common episteme.

The 'ecosystem' is a term that was iteratively developed during the 20th century to indicate the immensely complex interaction of biotic and abiotic factors within a defined locale, and has increasingly been characterised as a system whose operation is based on flows of energy between its constituent parts.[6] My investigation is structured around some of the key historical moments in the development and transmission of the ecosystem idea – for example, cybernetics, Gaia theory, and complexity – and will seek to examine the implications of the ideological investments that have informed Western writing on the ecosystem, whether popular or academic, scientific, philosophical or literary, asking how these representations construct our notions of the phenomena they purport to describe and so shape our behaviour towards the natural world.

[6] Forerunners, less successful competitors, and related terms of the 'ecosystem' concept include Edward Suess's 1875 idea of the biosphere, Forbes' 1887 'microcosm', von Uexkull's 1909 'Umwelt', Friederich's 1930 'holocoen', Thienemann's 1939 'biosystem', and Vernadsky's 1944 'bioinert body', which builds on Suess's biosphere. These terms are not further explored in detail in this thesis owing to the constraints of space, although the way in which Vernadsky's theory seems to foreshadow the Gaia concept is noted in a footnote to Chapter 3 and the idea of a lake as one of Forbes's microcosms is mentioned in a footnote to Chapter 5 (which takes as its subject matter Hejinian and Clark's 'The Lake'). Indeed, many of the ideas that inhere within our contemporary notion of the ecosystem have long historical roots in the work of earlier naturalists, for example reaching back to Antonie van Leeuwenhock's discussion of energy transfer (although he did not use this terminology) and Adolphe Dureau de la Malle's 1825 use of the word 'sociéte' to talk about groups of plants. More broadly, there is of course also a debt to many influential ideas in biology and sociology, such as those of Darwin and Malthus and Herbert Spencer._

In particular, this thesis will investigate how poets and critics in the 20th and 21st centuries have explored the ecosystem concept and its underlying ideas, whether in a way that C.P. Snow would probably have called 'getting them wrong', or in a more credible manner that offers a unique mode of inquiry into both the underlying science and the material world. I will consider how some of these ideas, or the cultural sources of these ideas, might have informed recent and contemporary poetic form (for reasons that will become apparent, my discussion will pay special attention to forms of poetry that are usually described as innovative or experimental). I will also consider how ecocritics writing about ecologically-orientated poetry have engaged with the ecosystem concept – particularly where ecological ideas have been invoked in order to describe texts – and whether these perceived parallels are valid. I will ask whether ideas drawn from ecological science, including the notion of ecosystemic complexity, can help us to theorise about experimental ecopoetry, functioning both as explanatory model and as a mode of analysis: that is, can we usefully conceptualise both biological systems and texts as types of complex system?

2. Methodology

This thesis takes an interdisciplinary, historicist and theoretical approach to its subject matter, which cuts across scientific, literary, and philosophical discourses. The overarching theme of this thesis is that we can use poetry to think, as well as feel, about our environment and how that environment has been represented in science (with specific reference to the ecosystem concept). I will firstly bring a historicist approach to bear in order to consider how poetry has processed ecological science over the 20th and 21st centuries, operating as a form of index or memory of scientific representation even as it critiques it, and secondly I will use a predominantly theoretical approach coupled with close analysis of poetry to consider how poetry and science could be models or analogues for one another as well as models of the environment. Together, these approaches will be used to demonstrate that poetry is a maximally powerful space for and mode of cognition, as well as an extension of cultural memory. This hybrid methodology is critical to the project and is one of the aspects that sets it apart from other work in the field. Firstly, the exploration of the science in the first section seeks to reveal what poets and critics are actually invoking when they compare texts and ecosystems. This allows us to think about the value of these cross-domain mappings. Secondly, it also enables a self-aware, detailed and experimental application of these ideas to texts as theory in the last two substantive chapters.

In terms of its historicist approach, this thesis draws on an examination of primary scientific sources such as journal articles and teaching textbooks dating from the relevant periods, together with secondary texts drawn from the history of ecology and the philosophy of science that theorise these concepts, in order to map the evolution of the ecosystem idea. I have focussed in particular on texts by the ecologists Frederic Clements, John Phillips, Arthur Tansley, Eugene Odum, James Lovelock, the biologists Humberto Maturana and Francisco Varela, and cybernetician Norbert Wiener and the systems theorist Claude Shannon, in an attempt to expose the underlying principles of their work and to illuminate how vestigial traces of their ideas continue to influence our contemporary notions of the ecosystem. I have then brought to bear an analysis of literary sources, predominantly poetry, in order to discover the common cultural progenitors of the ideas that inform the ecosystem and to examine the literary investigation of the models and metaphors that inform the science.

There are very few literary critical texts that deal with the developing notion of the ecosystem in their discussion of literary texts. Joshua Schuster's recent book *The Ecology of Modernism* does place modernist texts and developing ecology together in a chronology in a way that is similar to this thesis, but he does not cover second-order cybernetics, Gaia or complexity theory in ecology, and nor does his analysis go to the same level of detail, or examine the underlying metaphors that inform the ecosystem concept and the implications that these have for existing critical conventions. There are texts that look at the influence of cybernetics and system theory but in general they do not go into the history of ecology in any level of detail. Other than these minor exceptions there are no existing studies that place the science and philosophy of the developing 'ecosystem' idea over the course of the 20th and 21st centuries alongside literary and popular science treatments of the idea. This is a critical deficit that this work seeks to remedy, and it is an important exercise, because ecological crisis is a far-reaching problem that is not confined to any one discourse.

With regard to the second answer to the question of whether we can think *with* poetry, that is, to consider how we might use poetry (perhaps as a form of thought experiment, or as a type of model) to theorise about the Earth and to theorise about science, I will evaluate some existing literary criticism that uses the metaphor of living systems in its discussions of poetry, and I will also seek to perform similar comparisons myself. A strand of this thesis will therefore explore the ecocritical convention of borrowing scientific ideas in order to theorise about literary texts, for example the well rehearsed ecocritical tendency of

comparing texts with environments, or conceptualising poetry as a transfer of energy. Key points of congruence that are typically identified between poems and ecologies include the linking of texts and landscapes through the detection of a formal textual mimesis either of the landscape itself or of the sensory experience of that landscape. These ideas are often extended into the recurring metaphor of a 'textual ecology' or a 'textual ecosystem', which is of interest because it suggests that the environment, or perhaps rather our (scientific) representations of that environment, can help us to understand something about poetry and language. Yet these critical approaches often entail a relatively unexamined appropriation of the science, usually derived by way of popular science or environmentalism, and sometimes simply make generic assertions of ecological 'interconnectedness.' In each section of this thesis I will bring a number of literary critical resources to bear in order to consider how successful the types of criticism that draw comparisons between texts and environments have been, as well as attempting a similar analysis of the poetry myself in Chapters 4 and 5, which focus on work by Colin Simms and Lyn Hejinian.

In so doing I will seek to establish whether this poetry, alongside modelling the systems of the Earth itself, might be modelling other types of model, drawn from discourses such as ecology, or whether these perceived parallels derive from the shared cultural history and origins of diverse discourses, or whether, at the furthest reach of the investigation, there might be true underlying homologies between biological and textual systems. That is, there are useful analogies to be drawn between texts and ecologies because texts deliberately or otherwise are made to be like the Earth or model other models, or there are analogies to be drawn because a common zeitgeist informs our models (the foregoing are all horizontal analogies that work, if they work, by virtue of an overt or implicit *causal link* in how we think about text or science), or text and environments are homologous in that they are both types of complex system. In this latter example we can suggest that text and environment might be related in a 'real' as well as a conceptual sense, in a way that considers what this tells us about the Earth as well as about language. If these analogies or homologies do work, it would explain the recurring tendency of critics to invoke them, however loosely, again demonstrating that poetry is a space for 'thinking' as well as 'feeling.'

In pursuit of an evaluation of criticism that performs textual and biological comparisons, each chapter contains its own short literature review that seeks to offer one or two examples as to how the theme of that chapter has been explored in criticism to date and whether it has been applied as a methodology to aid in our readings of texts. Some texts, such as Don

Byrd's *The Poetics of the Common Knowledge*, and Andrew Fletcher's *A New Theory for American Poetry*, do broadly speaking apply autopoiesis or complexity theory to texts, but their analysis is some way removed from a detailed examination of these comparisons and given the constraints of space I have not chosen to cover these texts in depth. Autopoiesis is itself a difficult notion, with more than one incarnation over the course of the century in first and second order systems theory (as the historian of science Evelyn Fox Keller has explored), and there are no literary critical texts that I am aware of that acknowledge or explore this in any attempt to apply autopoiesis as a theory to help us to analyse texts.[7]

Some of the literary criticism that I consider is drawn from other schools than ecocriticism. This thesis sits at a critical intersection of ecocriticism, general poetry criticism, posthumanism, biosemiotics, work that applies complexity theory and chaos theory to texts, literary geography, and the philosophy and history of science. I have not sought to provide a comprehensive overview of ecocriticism in this thesis, although I do comment on some of its key themes and practices, because it is unnecessary for the work I am seeking to undertake. The antitheoretical orientation of what has been termed the 'first wave' of ecocriticism, its attempts to set the individual within a landscape, and its focus on non-fiction nature writing, Transcendentalism and Romanticism, have been thoroughly rehearsed elsewhere; the manifold exciting branchings of subsequent ecocriticism are too great to enumerate within the available space.[8] It is worth pointing out that even within more recent ecocriticism, which among other things concentrates on expanding the idea of subjectivity, there is still a dearth of critics who are prepared to deal carefully with the science or seek to offer a synthesis between philosophical approaches and literary texts – especially poetic texts of a more experimental nature.

I have paid particular attention to recent books by Sam Solnick (*Poetry and the Anthropocene*) and Joshua Schuster (*The Ecology of Modernism*) because these are of relevance for my purposes. I have also used Timothy Morton's *Ecology Without Nature* and *The Ecological Thought*, Dana Phillips's *The Truth of Ecology*, Jed Rasula's *This Compost* and various books by Marjorie Perloff to help to focus my analysis. Bruce Clarke and Cary Wolfe also make an appearance. Frank Golley's *A History of the Ecosystem Concept in Ecology* and Peder Anker's *Imperial Ecology* have both been very helpful, as has work by

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7 Evelyn Fox Keller, 'Ecosystems, Organisms, and Machines, *Bioscience*, December 2005, Vol. 55, No. 12: pp. 1069-1074.

8 For an excellent very recent review of ecocriticism, see Chapter 1 (pp. 19–64), Sam Solnick *Poetry and the Anthropocene: Ecology, biology and technology in contemporary British and Irish poetry* Routledge Environmental Humanities Series (Oxford and New York: Routledge, 2017).

current philosophers and historians of science such as Sandra Mitchell, Arnold van der Valk, Evelyn Fox Keller and Lily Kay, as well as essay collections such as Arnold's *Traditions of Systems Theory* and the complexity scientist Fritjof Capra's *The Systems View of Life*. The work of philosophers from previous generations is also referred to as necessary, including that of William James and Charles Sanders Peirce.

Together, the counterpart approaches of this thesis provide an original synthesis of interdisciplinary materials drawn from literature, the history of ecology, the philosophy of science, and complexity theory, as well as a substantial evaluation and overview of some of the recurrent critical approaches that have been brought to bear on texts from an ecological point of view. This combination of cultural history and theoretical, linguistic, and literary analysis, together with the individual reviews of criticism and the performance of detailed comparative exercises between texts and ecologies that I conduct, contributes to the growing field of ecocriticism. It operates as historical review, theoretical toolkit, and substantial review of criticism. One consequence of the choices I have made regarding the methodology and scope of the project is that it lends itself rather to complexity than to linearity: the thesis itself might be said to operate as a complex system rather than as a more conventional inductive analysis, and some of its insights arrive by way of emergence.

I have chosen to include some poets who are commonly thought of as 'ecopoets', whatever that troubling tag means, alongside some poets whose work does not explicitly pay sustained attention to ecological themes, at least in an overtly environmentalist sense.[9] The 'family' of poetry to which I pay the greatest attention is that whose line of inheritance runs from Gertrude Stein, through the work of Louis Zukofsky, to the Language writers in America including Lyn Hejinian, Marcella Durand, and Juliana Spahr, together with Colin Simms in the UK (who might also be named an Objectivist).[10] The choice of these poets serves my purposes in this thesis, partly for certain recurring formal concerns, partly for the direct attention many of them pay to science and/or their ambivalence towards science, and partly because all of them use poetic praxis as a way of thinking. Other poets do make an appearance, such as Gary Snyder, predominantly for his strong interest in the work of Eugene Odum, and I have briefly brought in other poets as and where I needed to do so. It should be noted that Snyder's work has had a great deal of ecocritical treatment because of

[9] Various attempts have been made to define 'ecopoetry' and 'ecopoetics' and to identify, by way of labelling or anthologising, a number of 'ecopoets' – a label that some resist as overly divisive or restrictive. Further discussion on this point can be found in the conclusion.

[10] Peter Quartermain identifies this genealogy in *Disjunctive Poetics: from Gertrude Stein and Louis Zukofsky to Susan Howe* (UK and New York: Cambridge University Press, 1992).

the explicitly ecological nature of his work, but there is less work that explores his engagement with science. Given the constraints of space and the wide interdisciplinary reach of the project, I have had to strike a balance with the analysis of individual poets, and the poems I have chosen to analyse are simply exemplars of the points I wish to explore. There is no doubt that the principles underlying my analysis could and probably should be expanded to a study of many other poets working in the 20th and 21st centuries, as well as to a fuller study of each of the poets whose work I use. This thesis seeks to stitch together a patchwork of examples that run alongside the scientific tropes, rather than providing a fully comprehensive overview of all poets writing in a particular modernist tradition or all who have touched upon ecology. I have not provided a great deal of context for Louis Zukofsky, Gary Snyder, or Gertrude Stein because they are relatively well-known, but I have said a little more about how the less well-known Colin Simms fits within this history, and a little about Lyn Hejinian and the tradition of Language writing. There is relatively little work in this thesis on UK poets, mainly because until late in the century the ecosystem idea was less ubiquitous here. I hope that the relatively concise analyses of the work of individual poets are more than compensated for by the wide and original reach into philosophy, history, cybernetics, complexity, and some of the primary texts of ecological science.

3. Summary of chapters

In the remainder of this section of the thesis I will introduce the ecosystem concept, offer some ideas about models and analogies in science, and then turned to the question of how and where texts and ecologies might intersect. There is a shift in emphasis in this thesis: the first three chapters are primarily arranged according to the history of science that they cover, and the last two sections seek to use second-order cybernetics and complexity science respectively as theoretical approaches to explore poetry by Colin Simms and Lyn Hejinian, although all of the chapters take both approaches to some extent.

The first three chapters of this thesis predominantly take a historicist approach. The first chapter thesis sets out the genesis of the ecosystem concept, mired as it was in political and ideological disagreement, and its constituent ideas of succession, climax, superorganism and system. Subsequent chapters then explore the developing ecosystem concept further, and also seek to bring poetry and criticism to bear on the history. The second chapter traces the controversial idea of the cybernetic ecosystem, and how this was received by poets such as Louis Zukofsky and Richard Brautigan. This is followed by a chapter that reviews the Gaia

hypothesis, which was enthusiastically espoused by Gary Snyder, and includes a discussion of autopoietic and symbiotic textual systems.

The subsequent two chapters then seek to apply ideas drawn from second-order cybernetics and complexity theory, the most recent incarnation of ecosystem science,, directly to the poetry as a theoretical model. In the fourth chapter I try to show how Colin Simms foregrounds the notion, derived from second order cybernetics, of the observer within the system and to explore what this tells us about literary and scientific systems of representation, and in the fifth chapter I discuss how Lyn Hejinian's recent work problematises notions of porosity and open and closed systems and also exemplifies the emergence that is a feature of complex systems. The conclusion brings us to a final discussion of the potential of the ecosystem concept as a lens that we can bring to bear on poetry in the modernist tradition and the potential of poetry as a lens on science and environment. One final point to note is that because many of the historical ideas that I bring into my discussion have both forward and backward chronological reach, they could legitimately have been included at more than one point of the chronology, and I have had to make a decision as to the most logical place for their inclusion. I have tried to indicate the historical reach of these ideas as far as possible.

4. The 'ecosystem' concept

Studying the history and philosophy of ecology swiftly brings to light the fact that – just as poets import scientific concepts into their work, with greater or lesser degrees of rigour as C.P. Snow pointed out – scientists also engage in some occasionally dubious intradisciplinary and interdisciplinary 'borrowings.' The epistemic interchange goes in various directions, not only between the sciences and literature but with other discourses too, whether in their more academic or their popular incarnations. Ecologists have approached the particular problems of the complexity and scale of natural systems with some creativity, combining material from fields as diverse as information science, philosophy, mythology, developmental biology, thermodynamics, and complexity theory. Such inclusions are sometimes problematic. The 'ecosystem' concept is a striking case in point, not deriving predominantly from experimentation but from these shifting metaphors and analogies, mainly as a result of problems of ecological observation and experimentation. Even now the 'ecosystem' is a palimpsest of incarnations and imported materials, at least in its popular version, most of which involve heavily anthropocentric and sometimes incommensurable elements. As Donald Worster has pointed out,

> ‘Every generation […] writes its own description of the natural order, which generally reveals as much about human society and its changing concerns as it does about nature. And these descriptions linger on in bits and pieces, often creating incongruous or incompatible juxtapositions.’[11]

The ecocritic Dana Phillips has argued that ecology’s chronic indebtedness to other sciences makes it appear overly metaphorical to outsiders, who, he suggests, have often regarded it as a fuzzily defined and value-ridden ‘point of view’ rather than as a coherent scientific enterprise in its own right.[12] Phillips contends that we should seek to understand the development of ecology as a struggle to divest itself of analogical, metaphorical, and mythological thinking, and to understand to what extent – if at all – these models are useful, adding that on this view, as analogies prove out practically, they in effect become less and less analogical.[13] However, as I will demonstrate, many of the constituent ideas of the ecosystem – particularly the earlier and the more emphatically holistic models – are not ‘proving out practically’, nor have they entirely disappeared, and in fact they are the progenitors of some ideas within popular contemporary incarnations of the ecosystem concept that may well be ecologically damaging. The underlying ideas of the ‘ecosystem’ concept will be explored throughout this thesis, but it is worth briefly listing some of the key developments at this stage.

Ecology is a relatively new science. The term ‘ecology’ was first used in 1866 by Ernst Haeckel, the German biologist, to name a new discipline that was emerging from forerunners in natural history, botany, and biology as ‘the science of relations between the organism and the surrounding outer world.’[14] At the beginning of the 20th century, post-Enlightenment depictions of natural phenomena as machines jostled for priority in the Western world with the Romantic and Transcendentalist emphasis on organicism, holism, and vitalism, as well as ideas drawn from a more modern physics. The German biologist Jakob von Uexküll used the word *Umwelt* (environment) for the first time in 1909. In 1925 the American biophysicist Alfred Lotka still conceptualised groups of organisms as engines,

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11 Donald Worster, *Nature's Economy: A History of Ecological Ideas*, Studies in Environment and History Series, 2nd edition (UK and USA: Cambridge University Press, 1994). This text was accessed online and no page numbers appear in the online version. The quotation is taken from the second page of Chapter 14.

12 Dana Phillips, *The Truth of Ecology: Nature, Culture and Literature in America* (North Carolina, USA Oxford University Press, 2003), p. 43.

13 Phillips, Dana, p. 58.

14 I have taken this quotation from the translation given in Capra and Luisi, p. 66, rather than the German original.

and this emphasis would reappear later in the century with the advent of cybernetics (a newer version of the machine/nature paradigm). Lotka's work also drew on the ideas of the physicist and philosopher Ludwig Boltzmann in order to conceptualise organisms as energy transformers and to suggest that competition for energy was the axis of natural selection, themes that would remain dominant for much of 20th century ecology.[15] In 1935, when the British ecologist Arthur Tansley first coined the term 'ecosystem' as a holistic ecological concept that combined living organisms and the physical environment into a system, he was seeking to define the fundamental 'unit' of ecology in order to establish a type of model, a way of reading the Earth's systems and recognising the complex interaction of all living and non-living things.[16] Unlike many of the other ecological terms that popularly endure, Tansley's ecosystem idea is processual rather than spatial, and, arguably, paved the way for a return to the machine metaphor in subsequent years.[17] His definition underwent substantial subsequent refinements and iterations, which must be read in the context of cultural trends that both informed attitudes to nature and also supplied some of the models and metaphors that fed into the ecosystem concept.

Tansley's definition should also be understood in the context of the contemporaneous ecological debate that spawned it. In his seminal article 'The Use and Abuse of Vegetational Concepts and Terms' Tansley was responding to ideas of the 'complex organism' and the 'biotic community' explored in a number of articles by the South African ecologist John Phillips, who had concluded that a biological 'community' in many respects 'behaves as a complex organism' and 'is more than the sum of its parts.'[18] In a political sense, Phillips's work reflected racial views common among the white population of South Africa at the time. From a scientific point of view his work depended upon that of the American plant ecologist Frederic Clements, who between 1916 and 1920 had developed the idea of the complex organism.[19] That is, Clements's work conceptualised groups of individual organisms of the same species in a single site as though each group constituted a complex organism undergoing cycles of birth, growth and development, or succession. In other words, the ecosystem was a type of superorganism.

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15 Alfred Lotka *Elements of Physical Biology* (Baltimore, USA, Williams & Wilkins Company: 1925).

16 Arthur Tansley 'The Use and Abuse of Vegetational Concepts and Terms', *Ecology*, Vol. 16 (1935), pp. 284-307, at p. 299.

17 For example, niches, corridors, habitat mosaics, ecotopes and patches, etc.

18 John Phillips 'The Biotic Community' *Journal of Ecology* 1931, 19, pp.1-24 at p. 20.

19 Frederic Clements, *Plant Succession: An Analysis of the Development of Vegetation* (Washington, USA: Carnegie Institute of Washington, 1916) and Frederic Clements, *Plant Indicators: The Relation of Plant Communities to Process and Practice* (Washington, USA: Carnegie Institute of Washington, 1920).

From mid-century onwards the development of cybernetics and systems theory became increasingly influential in various fields, including ecology, deriving originally from the work of thinkers such as Norbert Wiener, R. Buckminster Fuller, Claude Shannon and Warren Weaver. The ecosystem morphed into a type of cybernetic information system, according to ecologists such as Eugene and Howard Odum. Cybernetics is the science of communications and control systems in machines and living things, characterised by information networks linking all parts of the system together. On this reading, the key determining factor within an ecosystem was seen as the transfer of energy, in this case standing in for the transfer of information.[20] In 1968 the iconic image 'Earthrise' was taken from Apollo 8, showing the Earth as a strange and beautiful anomaly, a giant living system. This image was followed in 1972 by 'The Blue Marble' taken by Apollo 17, showing Earth as it appears from space: small, glassy, and vulnerable. These images, together with insights from cybernetics and James Lovelock's influential 'Gaia' hypothesis, imagined the entire biosphere as the ultimate ecosystem (and are popularly held to have galvanized the growing environmentalist movement of the late 20th century). In turn, cybernetic and holistic representations of natural systems began to morph into more contemporary notions of complex and pluralistic systems, complexity being an overarching theory used to describe artefacts of very disparate types from the brain through to the climate that appear to be 'more than the sum of their parts' because they feature self production (autopoeisis) and unpredictable emergence, and are adaptive and dynamic.

Autopoiesis was first articulated by the Chilean biologist Humberto Maturana and his student Francisco Varela in 1972 to describe the process by which a system maintains and reproduces itself. This would become one of the cornerstones of complexity theory, because one of the defining features of complex systems is that they are self renewing. Complex systems cannot be analysed reductively, because their operation depends upon the interaction between parts at all 'levels' of the system. These interactions are often based on the stochastic, the contingent, and on the operation of feedback. The component parts of any system must be analysed both in terms of how they are temporarily anchored by their context, and simultaneously themselves form the context for other parts.[21] These recent ideas offer an updated perspective on earlier notions of holism (and indeed the contemporary ecosystem concept has been criticised as a mere extension of Clements's superorganism

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20 See Norbert Weiner's *Cybernetics, or Control and Communication in the Animal and the Machine*, (New York and Paris, Wiley & Sons: 1948).

21 There are various different types of complex systems, from the entropic to the chaotic, and the 'edge of chaos' systems that includes ecosystems and (arguably) poetry.

idea). More recent still is the notion of 'ecosystem decay', which invokes ideas of radioactivity and hence of disaster, and reaffirms the tendency of ecologists to draw on physics for descriptive as well as analytical purposes.

Given the history that I have sketched above, it almost goes without saying that the ecosystem is a socially, culturally, linguistically constructed concept, a cognitive model originally created for a specific hermeneutic purpose that has been substantially extended, but what is perhaps less obvious – given the popular use of the term – is how relatively recent is its genesis. Whilst few concepts drawn from any scientific field may be taken as static, final, or comprehensive truths, many of the key concepts of ecology, including the ecosystem, are in a particularly nascent state of development. It is perhaps for this reason that traces of the constituent ideas of the evolving 'ecosystem', from succession and the superorganism, through to systems theory, cybernetics and Gaia, and on to complexity theory, remain embedded within the concept today, at least in its popular incarnation.[22] All of this must be understood against the background of the persistent metaphor of nature figured as machine. In an added complication, popular versions of scientific theories (for example, received ideas about Lovelock's Gaia theory) often import additional – and perhaps ideologically dangerous – dimensions into our understanding of what ecological systems are and how they operate.

The ecosystem's constituent set of models and metaphors might be seen to correlate with a broader pattern in the history of ideas, and particularly with some rapid epistemic changes that took place during the 20th century. Until relatively recently, scientific approaches to the world have tended to be dominated by a philosophical heritage deriving by way of Descartes from Greek philosophy, privileging mechanisms such as atomism, centralisation, determinism, linearity, reversibility, dualism, and equilibrium. Central to the Cartesian paradigm was the idea that in every system the behaviour of the whole could be understood entirely from the properties of the parts. Views that diverged in some key respects from earlier reductionism and atomism – although not necessarily from notions of stability and determinism – began to emerge, or, more accurately, to re-emerge, in the nineteenth century,

[22] For example, the ecosystem is described on Wikipedia (the online user-generated encyclopaedia that might be thought of as a hybrid between scientific and popularised viewpoints), as a *community*, linked together through nutrient cycles and *energy flows*. These phrases reference the 'communities' metaphor and the 'machine systems' metaphor. 'An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.'
'Ecosystem', W*ikipedia* <http://en.wikipedia.org/wiki/Ecosystem> [accessed 14 July 2014].

particularly in those strands of Romanticism and Transcendentalism that privileged organicism, vitalism and holism (themes that anticipate our contemporary orientation towards complexity, holism and pluralism). In Austria, the psychologist Christian von Ehrenfels used the word '*Gestalt*' (organic form) in the sense of an irreducible perceptual pattern, which he later characterised by asserting that 'the whole is more than the sum of the parts'.

In the early part of the 20th century, there was still a detectable push towards reinforcing notions of order, progression, and stability. The later part of the 20th century saw some shift in these ideas, coupled with shifts in political and ideological paradigms. Traditional structures, social and political, were challenged, with the civil rights movement in America, the end of dictatorships in, for example, Greece and Portugal, and the late 20th century 'science wars.' Two key sources of these new cultural currents were the early 20th century quantum mechanics with the radical challenge it posed to classical physics, and more recently the burgeoning sciences of chaos and complexity that developed from the second-order cybernetics model after the mid-century, and, similarly, of necessity entailed new ways of thinking. The Nobel-prize winning chemist Ilya Prigogine and the philosopher of science Isabelle Stengers wrote in their groundbreaking text *Order out of Chaos* (1984), 'Our vision of nature is undergoing a radical change toward the multiple, the temporal, and the complex… We now understand that we live in a pluralistic world.'[23] Awareness began to grow that time was not reversible and equilibrium not the natural order of things, that reductionist and determinist approaches were not alone sufficient for predicting or modelling complex, contingency-based, self-organising scenarios, and that a level of comfort with probabilism, fallibilism and pluralism was a basic requirement in understanding the complexities of the natural world.

Postmodern discourse, similarly, began to place greater emphasis on the distribution of representation, plurality, and local organisation, as opposed to the centralised models that had for so long dominated thinking and narrative conventions, and on contingency and chance instead of determinism and linearity. In a related move, some avant-garde poetry began the difficult attempt to excise the presence of the lyric subject and entrenched traditions of linearity (although, as Forrest Gander points out in *Redstart*, the dispersal of ego-centred agency in poetry is not new, reminding us that many of these trends are circular

[23] Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature*, (Toronto, NewYork, London, Sydney: Bantam Books, 1984), p. xxvii.

or recursive rather than linear).[24] Nonetheless, in mainstream fiction and popular science, as in orthodox ecological versions of the 'ecosystem', the invidious themes of centralisation, control, and equilibrium, proved surprisingly hard to jettison, and even now retain a broad and lingering resonance within our ideas of the natural world, whether in ecology or wider cultural discourse, probably deriving from an inherent anthropocentrism and, arguably, causing a certain level of actual damage. Our contemporary emphasis is on complexity, but this also entails ideas of order (although not necessarily of stability).

Of course, both the early and late analogies and descriptions contained within the ecosystem concept did not simply derive from the zeitgeist of their particular historical moment simply because they were useful in the attempts of a new science to describe or predict the unobservable or the multifarious. They also had a wider ideological usefulness. As the ecologist and historian Frank Golley pointed out, the ecosystem concept explicitly promised to show how Americans could manage their environment through understanding the structure and function of ecological systems and by predicting their responses to disturbance.[25] The natural world could, according to these ideas, be managed or controlled. This aspiration was especially visible within the narrative of succession and within the cybernetics metaphor – a theory that once again characterised the ecosystem as a machine, postulating the reassuring existence of a large complex entity, self-organised and self-regulating. Cybernetics evoked ideas of ultimate order, balance, equilibrium, and a rational and logical system of relationships.[26] Stability, order, uniformity and equilibrium are all features of machines, but they do not necessarily apply to living systems, although many scientists from the Enlightenment onwards – including Darwin – have continued to conflate the two. These themes of the putative management and control of natural systems had a broad resonance in the 20th century, at least until the publication of Rachel Carson's *Silent Spring* in 1962.[27] Implicit in Carson's critique of the attempt to control nature is her scientific understanding that ecosystems' innate complexity and self-organising tendencies will always condemn such hubristic attempts to failure – and to new and dangerous types of emergence. As such, Carson's book was at the vanguard of nascent ideas about complexity and sat in counterpoint to control based theories.

It seems therefore that after almost a century of accumulations and revisions, the ecosystem concept carries heavy ideological baggage, and is riddled with inconsistency. It must be

24 Gander and Kinsella, *Redstart*, p. 11.
25 Golley, p. 2.
26 Golley, p. 3.
27 Rachel Carson *Silent Spring* (Boston, New York: Houghton Mifflin Company, 1962).

'read' very much with an eye to its historical and ideological heritage. 'Ecosystem' is also a particularly slippery and unstable word in another sense, not only because of the imported material from developmental biology, cybernetics and so on, that it incorporates. At one level of analysis, there is no such thing as an 'actual' ecosystem in the world – it is simply a convenient label used to describe what appear to us to be particular spatial and temporal *groups* of dynamic interactions, parcelled up for analysis. There are some practical problems in delineating any particular ecosystem as the object of study (at least at any level below which the Gaia idea envisages), not least the spatial question of where it begins and ends, as well as the level of organisation at which the ecosystem exists. It is perhaps for this reason that many of the early studies involve lakes, which appear to have genuine 'boundaries.'

It might perhaps be reasonable to delineate a lake as one ecosystem, and the surrounding land as another, with the area between them figuring as an 'ecotone' (edge zone), but in other types of terrain our identifying of levels and boundaries can seem dangerously reductive, or even misleading, as it can in terms of levels of organisation. The transfer of energy (and/or information) and the operation of feedback occur across these putative 'boundaries.' Yet we often implicitly assume these models refer to 'real' systems and 'natural' boundaries that are at least partially 'closed.' Additionally, the word ecosystem is popularly used, without any explicit nod to its scientific provenance, to describe (perceived) interactions in the natural world. This point becomes particularly important when thinking about how 'ecosystem' might be used by poets and critics: if we wish to disentangle its history of cultural engagement, we need to distinguish between the 'ecosystem' as the polyvalent 'scientific' concept described above, something that seeks to delineate and represent an underlying materiality, and its other popular use to mean that underlying material world itself, to indicate what – for the want of a less ideologically loaded word – we could term 'nature.' It is also worth noting that it is not always possible to identify in any given example which of these meanings are in play. Although sometimes there is a clear intention to invoke the science, more often both meanings are relevant, and we must also recollect the way in which terms 'evolve' when they escape from the lab or the field into less formal scientific discourse.

5. Models, metaphors and analogies in ecology

The models and analogies that have been used to frame the ecosystem concept for both explanatory and heuristic purposes have significantly shaped the emerging discipline of ecology. As the French philosopher of science Georges Canguilhem pointed out in 1961,

analogical models are more common in the biological sciences than mathematical models.[28] This is presumably because analogical models are particularly useful to describe and explore biological systems because those systems have no exceptionless, fundamental laws, but only contingent, local truths from which it is at best possible to draw exception-ridden, non-universal true generalizations.[29]

Of course, comparisons of all kinds, particularly models, analogies, and metaphors, constitute some of the key cognitive tools at our disposal to understand – and to disseminate – complex ideas and processes, such as interactions within an environment. Metaphors and analogies can even provide hypothetical models of phenomena that have not yet been observed by basing speculation on current knowledge in other fields of inquiry, and can also assist in establishing, explaining or broadening the appeal of a particular concept or framework, by attaching it to better known ideas, or by giving it a recognisable identity. There is an entrenched tendency to employ particular political and social analogies to justify or render acceptable new biological ideas (Darwin's work, for example, drew extensively on notions of political economy derived from the work of Adam Smith, Thomas Malthus, and David Hume), just as, conversely, metaphors drawn from the natural world are often used to justify or 'naturalise' social or political ideologies.[30]

New scientific fields and strains of thought often find their way initially by reference to concepts drawn from other scientific and philosophical fields and much work has been done on this which need not be reiterated here beyond noting a few key points (although a longer explanation is given in the notes, for the interested reader). In Britain, as distinct from continental Europe, discussions as to the role of models and analogies in science often take their framework from the very useful work of the philosopher of science Mary Hesse.[31]

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28 Canguilhem, Georges, 'The role of analogies and models in biological discovery', in *Scientific Change: Historical studies in the intellectual, social and technical conditions for scientific discovery and technical invention, from antiquity to the present',* from the Symposium on the History of Science held at the University of Oxford 9-15 July 1961 (London, Heinemann: 1963), pp. 507-520 at p. 507.

29 See for example Sandra Mitchell, *Unsimple Truths: Science, Complexity and Policy*, (Chicago, USA and London, UK: University of Chicago Press, 2009), pp. 49, 50-51 and see also 'Pragmatic Laws', *Philosophy of Science*, 64, Supplement (1997), pp. S468-S479.

30 See Gillian Beer *Darwin's plots: evolutionary narrative in Darwin, George Eliot and nineteenth-century fiction*, 2nd edition (Cambridge: Cambridge University press, 2000), for an extensive discussion of analogy in Darwin's work. Beer's book has set the tone for much of the study of science and literature in the UK in subsequent years.

31 Mary Hesse *Models and Analogies in Science* (London: Sheed and Ward, 1963). Hesse's work sits within a wider context of thinking about how science is explained, and how science is confirmed. To take scientific explanation first, according to Salmon, most scientific explanations fall into one of three categories of (i) explanation as argument (the erotetic), (ii) explanation intended to describe a causal structure (the ontic), and (iii) explanation that aims to describe why events had to happen in terms of necessary laws (the modal). See Wesley Salmon, *Scientific Explanation and the Causal Structure of the*

Hesse argued that models and analogies were essential in terms of the construction and expansion of scientific theories.[32] There is also an extensive body of work in the history and philosophy of science on how these theories, as constructed from models and analogies, might subsequently be confirmed or otherwise. One of the dominant thinkers in the 20th century was Karl Popper, who argued that in order for a proposition to qualify as a theory it must in principle be falsifiable; if it is not, it is merely a myth. Popper's thinking, which he termed critical rationalism, was positioned in contradistinction to earlier approaches such as empiricism which privileged reasoning from experience.[33]

Building on these foundations, more recent philosophers and historians have also considered the prevalence of analogical models in science. Two recent historians of biological science, Evelyn Fox Keller and Lily Kay, have paid explicit attention to both the danger and potential of some of the linguistic aspects of scientific models and analogies. Analogical models might enable scientists to exploit the potential of creative thinking in order to extend the boundaries of established knowledge, by exploring latent possibilities connoted by a particular metaphorical vehicle, or as Fox Keller put it, by making 'productive use of the cognitive tensions generated by ambiguity and polysemy.'[34] Fox Keller explicitly noted the usefulness of the scientific propensity to exploit the connotations as well as the denotations of words, allowing scientists to think along the edges of what is known and to profit by the creative potential of unforeseen links. As she explained,

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World (USA: Princeton University Press, 1984). Hesse herself does not have much to say about explanation; she is more concerned with theory construction, which takes place by way of observables and/or models, and involves three phases: discovery, plausibility, and confirmation. There is a wider context of work on confirmation (which expresses a relationship between evidence and hypothesis, relative to context) such as Baconian inductive reasoning and Popper's thinking.

32 Hesse's taxonomy encompassed the types of model that could be used in theory construction, $model_1$ (composed of positive and neutral analogy) and $model_2$ (composed of positive, neutral and negative analogy). A positive analogy is one in which the two analogues are known or believed to share features, a negative analogy is one in which the analogues are known or believed not to share features, and a neutral analogy is one in which the status of the analogues relative to one another is not yet known. These analogies support theory construction in a two step process, by identifying through observation correspondences in the two analogues, and constructing a target theory on the basis of the source.

33 For a fuller analysis of the shift in scientific methods in Britain between 1830 to 1917 from inductive to hypothetical-deductive approaches see Richard Yeo 'Scientific method and the rhetoric of science in Britain, 1830-1917' in *The Politics and Rhetoric of Scientific Method*, edited by J.A. Schuster and R.R. Yeo (Dordrecht: D. Reidal, 1986), pp. 259-297.

34 See Evelyn Fox Keller, *Making Sense of Life: Explaining Biological Development with Models, Metaphors and Machines*, (USA: Harvard University Press, 2002), at p.7.

> ‘the construction of scientific meaning depends on the very possibility of words taking on different meanings in different contexts – that is, it depends on linguistic imprecision.’[35]

The scientific use of metaphors and analogies, then, can serve to take knowledge beyond that which might be falsifiable, and may operate to extend a discipline into the realm of conjecture and myth. Indeed, as some scientists, theorists and philosophers have pointed out in discussions of the role of metaphor in science, metaphors, analogies and models in effect end up constructing the very ‘knowledge’ they purport to describe, for example through determining the manner in which observed phenomena might be studied and through determining the interpretation of observed results. The idea of language constructing or reifying ‘reality’ rather than transparently expressing it is, of course, one of the central tenets of much 20th century theory, and Lily Kay has extensively critiqued one example of this phenomenon, exploring the resonances of the representation of genomic structures and operation through metaphors drawn from linguistics, information theory, cryptanalysis, and scriptural ideology, which took over from earlier representations of ‘specificity’ and ‘organisation.’ Kay presents the ‘language of DNA’ as not merely popularisation or the rhetoric of persuasion, but as actually constitutive of scientific ‘fact’, as a ‘representation *qua* intervention with operational force.’[36] These usages thus contribute to linguistic evolution. Kay explains that:

> ‘Metaphors may work both ways; they select and emphasize or suppress features of the primary; new slants on the primary are illuminated so that the primary is seen through the frame of the secondary. With time [...] the secondary can also be reshaped by the primary.’[37]

As the biological examples explored by Fox Keller and Kay demonstrate, the wide discursive reach of the ecosystem concept is not particularly unusual. Nor does this wide reach indicate anything particularly unusual about ecology as a practice, other than the relatively recent date of its establishment as a discipline and its ongoing need to authenticate

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35 Evelyn Fox Keller, *The Century of the Gene*, (USA: Harvard University Press, 2002), p.141. Fox Keller also recognises the limitations and inaccuracies that may also result from this propensity (for example, see Keller’s critique of the language of the nature/nurture dualism (Evelyn Fox Keller, *The Mirage of a Space between Nature and Nurture*, (USA: Duke University Press, 2010)).

36 Lily E. Kay, *Who Wrote the Book of Life? A History of the Genetic Code*, (Stanford, California: Stanford University Press, 2000), pp. 24 and 1.

37 Kay, p. 22. Kay criticises the resulting tendency towards biological determinism, viewing information discourse as a form of biopower, and argues that these representations curtail or misdirect scientific inquiry.

itself, and certain logistical problems of observation, experimentation and representation. Together these factors account for the prevalence and extent of the metaphorical and analogical thinking that can be identified within ecology's intellectual frameworks.

What *is* striking about the ecosystem concept, in almost any of its multiple incarnations, is that many of its underlying ideas, hypotheses and analogies stop short at the model stage of theory construction, and before the confirmation stage. Some, indeed, are not even hypothetically falsifiable as theories, bringing us dangerously close – as Popper would have seen it – to the realm of myth. Furthermore, in terms of the models that were used in the constructions of these 'theories' (I use the word loosely here), some of the comparators that were chosen bore little observable resemblance to the target. Whilst we might assume that these analogies would, for example, exhibit some non-trivial similarity of horizontal relations, in fact a number of them would not hold up to the most casual scrutiny in this regard (a signal example of this is Clements's idea of succession and the 'complex organism').[38] Studying this history also reveals that some of the ecosystem's constituent models, metaphors and analogies, as we shall see, were deliberately employed in an instrumentalist fashion for the purposes of social and political engineering, rather than to elucidate anything about the environment and the interactions within it.

A further barrier to finding models that would offer a more reasonable approximate basis from which to develop theories was that in one very important sense early ecologists were in effect working in the dark: ecology suffers from some particular problems of observation and representation. By this I do not mean to imply that ecology's problems of observation and representation are greater than those of, for example, quantum physics – for quantum physics, infamously, suffers a yet further problem of observation, that phenomena seem to exist in different states simultaneously. As Daniel Tiffany points out, whilst, as a result of increasingly powerful technical media and visual enhancement, 'the idea of a material occult – a realm of phenomena that can be grasped only through the imagination – is anathema to modern science', nevertheless this imaginary, material domain is an inescapable feature of physics.[39] As it turns out, the problems of physics are similar to those of ecology in that it is difficult to discern isolated building blocks of matter; it rather appears as a complex web of relationships between the various parts of a whole, hence the appearance of uncertainty and

[38] That is, comparisons of the type that Mary Hesse would term 'Type C', relational similarity.

[39] Tiffany, Daniel. *Toy Medium: Materialism and Modern Lyric* (Berkeley, Los Angeles and London: University of California Press, 2000), p. 3.

quantum superposition.[40] However, quantum physics is more obviously theoretical than ecology appears to be (at least at first glance), its problems of representation are well known, and its subject matter is strange to us so we make fewer assumptions about what we know, at least rendering its theorising more overt. Ecology's 'invisibilities' are more 'invisible' than that.

The particular problems of observation and representation that bedevil ecology are manifold and significant. Firstly, ecologists, like physicists, need to be able to perceive or imagine phenomena that are outside our ordinary frame of reference or personal scope or scale; things that, relative to human lives, are very large, very small, very fast or slow or particularly complex, which render them to all intents and purposes concealed. With our life spans and perspectival limitations, it is particularly difficult to avoid the 'ephemeral fallacy' when studying the natural world – that is, the mistake made by a transitory being who believes in the immutability of things. It is difficult to conceive of, let alone to conceptualise, model or represent, what one cannot actually see or experience first-hand. For example, the vast scale of the time and geological landscape against which the slow and directionless drama of evolution is continually played out, through repeated cycles of change, adaptation, and genetic and phenotypic intensification is probably a major reason why the operation of natural and sexual selection has only relatively recently become apparent. The insights of Wallace and Darwin in the mid-nineteenth century were necessarily based on advances in geological understanding. At the other end of the spectrum, the increments through which this mechanism operates are miniscule, not only in terms of actual physical size – much of genetic mutation, trait selection and epigenetic feedback occurring at a molecular and sub-visible level – but in terms of the rapidity with which they occur, even in multicellular organisms. Ecology suffers from particular spatial challenges as well. The relationships, processes and connections that feed into species distributions across regions are not easily quantifiable, and whilst they might appear to follow particular patterns, it is not always clear why this might be the case.[41] Ecologists might attempt analysis of one species as a model for all, as a way round these issues, but this is reductive and highly problematic. The opportunities for meaningful 'natural experiments' are rare.

Another way in which scientists are limited by their own temporality is cultural. Science, like many approaches to knowledge, is limited by the state of the art at any given time. Collective knowledge, according to some thinkers following Thomas Kuhn, is non-linear

40 See for example Capra and Luigi at p. 68.

41 For example, faster speciation in warm climates, etc.

and undergoes periodic 'paradigm shifts' and it is difficult or impossible for us to anticipate the next scientific development.[42] A separate problem is that scientific histories often retrospectively edit out what appear to have been scientific 'blind alleys'. Research in epigenetics, for example, now seems to suggest that Lamarck's ideas of the heritability of acquired characteristics, which were dismissed for much of the 20th century, partly because of their subsequent association with Lysenkoism, may turn out to be more correct than was once thought (although not via the mechanisms that Lamarck suggested). Scientists, artists, philosophers and poets alike are hampered by difficulties in anticipating scientific knowledge, and in evaluating it in retrospect, coupled with the danger of reading into cultural histories anachronistic values or knowledge (presentism). In a more general sense, too, the broader Western epistemic heritage also went some way to determining how successive ecological models were arrived at and which ones went on to feed into dominant paradigms, as I discussed in the previous section.

The final problem is that of complexity, and it is a substantial problem. We now have an inkling that the environment in which we live is complex in a way that is almost impossible to represent even now, let alone before the advent of powerful computers in the 20th century. Golley points out that early ecological investigation was almost entirely observational. The ecologist studied a community by observing the presence, absence and abundance of various organisms and interpreting those patterns. The ability to understand such complex and multiform patterns does depend heavily on the mathematics and instruments used to process quantitative data, which at the time were 'crude', and certainly inadequate to what we now know is a complex world.[43]

Sandra Mitchell, a contemporary historian and philosopher of science, explains that complexity often carries with it a type of ineliminable or 'deep' uncertainty that is not adequately represented by methods more suited to more certain, predictable, and static parts of nature. Some of the uncertainty arises from ignorance of the many factors that contribute to complex processes, and some arises from the operation of chance or chaos affecting the process itself.[44] Mitchell characterises the multiple kinds of complexity that arise in biological systems in particular as multilevel organization, multicomponent causal interactions, plasticity in relation to context variation, and evolved contingency. She

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42 Thomas S. Kuhn *The Structure of Scientific Revolutions* (Chicago, London: University of Chicago Press, 1964).

43 See Golley, pp.19-20.

44 Sandra Mitchell *Unsimple Truths: Science, Complexity and Policy* (Chicago, USA and London, UK: University of Chicago Press, 2009), pp. 3-4.

concludes that understanding that complexity is *itself* variegated in its 'kinds' is essential to how we approach it.[45]

In addition to these considerations, with complexity there is the imperative to think both locally and globally. In terms of the local, it should be remembered that most macroscopic species have relatively small and specific ranges. One also has to consider accessibility for study: for example, there are more species of fish than there are of terrestrial vertebrates combined, but little is known about many of them. In terms of the global, certainly, it is imperative to assess connections between species, but it is also important to analyse and seek to address significant gaps in global coverage of protected areas.[46] Ecologists also need to conceptualise the manifold connections, both physical and to some extent mental and cultural, that link humans and nonhuman organisms. They need to be able to analyse their subject matter in terms of molecular, cellular, individual, population and/or planetary levels of organisation.

As a result of all of these factors, one criticism with which the ecosystem model continues to meet is that of over-simplification in the face of a massively complex world. What is less often remarked upon is the ideological danger resulting from its choice of models and analogies. Indeed, it is noteworthy how far ideas about the ecosystem have become naturalised, by contrast with, for example, the mixed reception of the metaphors and analogies that supported Darwinian evolution, probably because in certain respects the ecosystem analogies are less challenging: in effect they are highly anthropocentric and actually work to reinstate the importance of both mankind and machine. The Gaia idea – if not in Lovelock's formulation, at least in its popular reception – simultaneously reinstates the superorganism idea and resurrects the longstanding, and problematic, personification of nature as female (as well as incorporating some rather unsettling notions of systemic consciousness). The 'cybernetic' version of the ecosystem indicates a clear return to the machine metaphor for nature; like other incarnations of the concept it implicitly asserts the reassuring (but misleading) possibility of reversibility, control, and machine-like predictability. It is precisely because we have so easily assimilated the constituent ideologies of the ecosystem idea that the underlying scientific metaphors, models and analogies merit examination.

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45 Mitchell, pp.21, 24, etc.

46 For example, the Rift Valley Lakes, which have no legislative protection but which constitute one of the richest and most diverse areas on Earth.

6. Intersections between texts and ecologies

A related example of the use of models and analogies from the literary end of the disciplinary spectrum, which is also of central relevance to this thesis, is the critical tendency to describe texts themselves in terms of ideas drawn from the material environment or from scientific ideas about the environment. This tendency has a mixed heritage and sits within a wider literary critical tendency to use ideas from the sciences to reveal, by analogy, something about language and cognition.[47] The comparison between texts and ecologies might also be said to derive one limb of its heritage from the New Critical and Russian formalist emphasis on organicism, in a reprisal of long-established ideas of art as a living thing, of thought finding its own organic form. The organicist approach foregrounded the need to perform an analysis of the dynamic relations between the parts of a poem that resulted in its perceived overall unity of form and content.

The text/world comparison is part of the earliest ecocritical paradigm and includes invoking aspects of the material world, or received and more or less scientific ways of describing the material world, to describe texts. These comparisons range from conventional assertions of spatial text-to-world and page-to-landscape correlation, to, for example, suggesting that reading a poem involves an 'energy transfer', explicitly describing a poem as an ecosystem, or otherwise suggesting that texts may be understood as organic systems containing dynamic (presumably four dimensional) 'ecological' relationships. It is fair to say that not all of these comparisons are rigorous, and sometimes the driving force behind them seems to be political rather than anything else.[48]

An early instance of the idea of poetry as a medium for the transfer of energy, and, as it turned out, a precursor of the ecocritical text/ecosystem comparison, appears in Charles Olson's famous essay on open field poetics, 'Projective Verse' (1950).[49] Olson was using physics as the source of his metaphor, rather than biology or ecology.[50] According to Olson,

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47 Drawing analogies between texts and the material world is not confined to ecocriticism, and is not simply because eco-criticism is a new(ish) discipline; a number of scholars describe literature in terms of ideas drawn from other sciences from classical physics through to quantum mechanics, such as the fragmentary nature of experimental texts representing the atomistic, the simultaneous, and the uncertain (see for example Daniel Albright, *Quantum Poetics: Yeats, Pound, Eliot, and the Science of Modernism* (Cambridge, UK: Cambridge University Press, 1997)). Thus this tendency is not simply something from which more established strands of criticism have moved on but which ecocriticism still needs to process.

48 See for example Dana Phillips's characterisation of both (early) ecocriticism and nature writing as posturing, utopian, anti-intellectual and anti-theoretical. Phillips, pp. 43, 44, 51, etc.

49 Charles Olson, 'Projective Verse (1950)', in *Poetry in Theory*, ed. by Jon Cook (Massachusetts, USA, Oxford, UK and Victoria, Australia: Blackwell Publishing 2008), pp. 288-95, at p. 289.

50 See Peter Middleton *Physics Envy: American Poetry and Science in the Cold War and After* (Chicago, USA: University of Chicago Press, 2015), pp. 99-100.

because the open field poet is not using the restraints of received forms, he or she is especially confronted by the problem as to how the 'energy' of the poem might be transferred to the reader. In Olson's formulation, the transfer of energy seems to be acting as a metaphoric vehicle for the revelation of meaning, information, knowledge, the aesthetic response and the affective resonance and so forth that we might reasonably expect to experience on reading a poem. The 'energy' motif also suggests that Olson was trying to invoke ideas of momentum, dynamism, velocity. It also echoes Muriel Rukeyser's formulation in 1949 that 'Exchange is creation. In poetry, the exchange is one of energy. Human energy is transferred, and from the poem it reaches the reader.' Rukeyser's title suggests that in some important sense poetry is actually alive, which anticipates some very recent literary theory based on systems theory, as we shall see, and also recalls organicist and Kantian ideas of texts being endowed with purposiveness.[51]

Whilst Olson did not have ecology's trophic dynamics (the flow of energy as food within ecosystems) in mind in thinking about the transfer of energy, his ideas seem to have been hybridised with ecological ones by subsequent literary theorists, in a way that parallels ecology's own borrowing from physics. The 'transfer of energy' account chimes with William Rueckert's idea of the poem as an ever-living, inexhaustible source of 'stored energy', and it may be that Rueckert had Olson's or Rukeyser's work in mind, whether consciously or not, when he wrote his 1976 essay 'Literature and Ecology.'[52] Alternatively, it is possible that Rueckert had been reading a recent interview with the poet Gary Snyder, in which it was made explicit that 'poetry as energy transfer' packed a powerful punch:

> 'H. T. Odum says that language is a form of energy trap, and that particular kinds of communications which he calls tiny energies in precise forms released at the right moment amount to energy transfers that are much larger than their size would indicate – which is what poems are, from an ecological energy-systems man's point of view.'[53]

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51 Muriel Rukeyser *The Life of Poetry* (New York: Current Books, 1949), p. 185.

52 William Rueckert, 'Literature and Ecology: An Experiment in Ecocriticism', in *The Ecocriticism Reader: Landmarks in Literary Ecology*, ed. by Cheryll Glotfelty and Harold Fromm (Athens, Georgia: University of Georgia Press, 1996), pp. 105-23., at pp.108–110. Rueckert is the scholar credited with naming ecocriticism as a critical practice, although, clearly, studying texts in relation to environment was not a new exercise in the 1970s.

53 Lee Bartlett 'Interview: Gary Snyder' *California Quarterly* 9 (University of California, Davis) 1975, pp. 43-60 at p. 48. It has not been possible to obtain this article directly. I have quoted the excerpt contained in Allan Johnston 'Ecology and Aesthetics: Robinson Jeffers and Gary Snyder' *Interdisciplinary Studies in Literature and Environment* 8.2 (Summer 2001), pp. 13-38 at p. 17.

The ‘transfer of energy’ idea also recalls Forrest Gander and John Kinsella’s much more recent description in 2012 in *Redstart: An Ecological Poetics* of a poem as a ‘curiously renewable form of energy’, and the American poet Marcella Durand’s 2002 assertion that contemporary ecologically-orientated poetry contains ecological processes:

> ‘Ecopoetics showcases a more experimental ecological poetry, one that begins to take into itself ecological processes, as well as ecological concerns.’[54]

A number of critics have also considered poems as complex systems and/or as autopoietic, or otherwise drawn extensive analogies between texts and environments.[55] In his article ‘Ecology as Text, Text as Ecology’ Timothy Morton has drawn attention to some perceived similarities between texts and ecologies, as the title suggests, and I will return to this towards the end of this section.[56] Another recent example is the work of the prominent critic Jed Rasula, who in his 2002 book *This Compost* made extensive use of the idea of compost – which is, similarly, all about energy exchange – as a broad metaphor for intertextuality.[57]

In the 2004/2005 issue of *ecopoetics*, Jonathan Skinner pithily characterised this type of criticism as ‘tropological’ ecocriticism, one of four categories that he identified. Tropological criticism, in Skinner’s words, consists of ‘exercises in analogy, casting poems as somehow functioning like ecosystems or complex systems, troping on language and ideas from the environmental sciences.’ Another of Skinner’s categories, which he terms ‘entropological’ poetics, is also relevant for the purposes of this thesis, consisting as it does of a practice engaged at the level of materials and processes, ‘where entropy, transformation and decay are part of the creative work.’[58] These early ecocritical metaphors and analogies are still very much extant in the 21st century, and comparisons continue to be drawn

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54 Forrest Gander and John Kinsella, *Redstart: An Ecological Poetics* (USA: University of Iowa Press, 2012), at p.10. Marcella Durand, ‘The Ecology of Poetry’, *Ecopoetics*, 2002, p. 58.

55 This critical tendency is of particular relevance for the purposes of this thesis, and will be covered in more detail in each of the subsequent chapters. It is worth listing here a few examples that I will not revisit. See Claudia Simone Schlee, 'The Poem as Periodic Center: Complexity Theory and the Creative Voice in Nietzsche, Gottfried Benn and Wallace Stevens' (Vanderbilt University, 2007); Claudia Simone Schlee, 'Poetry as Compass: Chaos, Complexity, and the Creative Voice', *University of Edinburgh Postgraduate Journal of Culture and the Arts*, (2006); and Bronwen Hudson’s undergraduate thesis: Bronwen E. Hudson, 'Poetry as a Complex System' (University of Vermont, 2014).

56 Timothy Morton, ‘Ecology as Text, Text as Ecology’ *The Oxford Literary Review* 32.1 (2010): pp. 1-17.

57 Jed Rasula *This Compost: Ecological Imperatives in American Poetry* (Georgia, USA: University of Georgia Press, 2002).

58 Jonathan Skinner ‘Statement for “New Nature Writing” Panel at 2005 AWP (Vancouver), *ecopoetics* 4/5: pp. 127–129 at p. 128. The other two categories that Skinner identifies are the topological, which covers the referential function most ecocritics privilege, referring to an outside to the poem, and the ethnological, which takes us beyond Western languages and cultures.

between poems and ecosystems, between conceptual schema and ecologies, and between the complexities of language and the complexities of the material world. One of the key questions of this thesis, to which I will return in each chapter, is the extent to which these types of criticism are valid and valuable.

Comparisons between text and world, and text and ecosystem, can happen in various directions. For example, we can talk about a poem as though it is an ecosystem, and we can talk about an ecosystem being modelled in or by a poem. When we present a poem as an ecosystem we are suggesting that a poem may resemble an ecosystem in some respects and that one can learn something about how the poem and its constituent parts operate together by thinking of it as though it is an ecosystem. That is, 'text as nature' or 'text as ecosystem' analogies can be used as an interpretative strategy for reading poetry. Although the text/ecosystem comparison is infrequently drawn in the other direction – that an ecosystem can be 'read' as though it is a text, for example – when we describe a text as being an ecosystem we are presumably nonetheless also saying something about ecosystems, whether intentionally or not: that is, that ecosystems are comparable to poems, and that ecosystems operate in the same way as the connections and transfers of 'energy' and information within poetry.

The prevalence of text/ecosystem type comparisons in ecocriticism invites two linked questions: why we continue to draw them, and the ancillary point as to how valuable this exercise is. Clearly, there are problems with drawing these sorts of comparisons, including the obvious point that not all analogies are good analogies, and not all interdisciplinary borrowings are defensible, as I have already discussed. A particular complication with this exercise arises because, as we have seen, the scientific concepts that are being invoked to describe texts are themselves only a century or so old and already a jumble of vestigial metaphor and analogy, richly connotative and full of potential or, to put it another way, heavily loaded and very dangerous: ecologists are not in a position to mock literary critics when it comes to drawing questionable analogies. When we invoke the ecosystem to describe a text there are various possible loci for slippage: the problematic pairing of natural and textual systems in the first place (where 'ecosystem' is being used in the popular fashion to describe the 'real' world), together with the instability of the concept as it is used in science and the disparate set of ideas that informs the concept. There is also the crucial question of whether ecocriticism claims too much for these parallels.

Perhaps the answer to both of these questions – why we draw these comparisons and how valuable they are – comes down to how far we can identify genuine points of similarity between texts and ecologies, but perhaps they don't: literary analysis may place a different value on quantifying the observable correlations of analogues in its model-making than science, in part because its focus is different. In literary criticism (as opposed to science) we are not, in any very strong sense, at least, trying to 'prove' anything or, in line with Popper, falsify anything, although, just like ecology, we are often engaged in a process of the representational modelling of complex and dynamic *processes*. Still, that does not mean there is a place for complete laxity in our thinking; we should concur with Jeremy Prynne, as he wrote to Charles Olson in 1964, that:

> 'analogy is the means by which we finally do come to know; the cognate, parallel utterance.' *But this is only the case* if the 'whole pattern is allowed its substantive integrity, and not merely employed as rhetorical ornament.'[59]

Certainly, it is implicit in the argument of the American scholar Dana Phillips that literary critical comparisons must reveal genuine similarities: he concludes that, as he sees it, there are no significant points of resemblance between texts and ecologies, rendering this type of analogy at best 'overstated' and at worst 'entirely false.' In *The Truth of Ecology* (2003) Phillips argues that:

> 'Poems and ecosystems are entirely different kinds of artefact. Poems are deliberately written, they don't just happen, and they must be deliberately read. That is, we have to think about what poems mean, and luckily for us, they remain stable no matter how many times we peruse them: titles are fixed, word order and rhyme schemes do not change, stanza breaks occur in the same places, and so on. Ecosystems, by contrast, are the passive result of evolution. They do just happen, and are dependent on the whims of the weather and the fortunes bestowed upon them by geography. They don't mean anything, and they change constantly. Thus there really is no point in comparing poems to

[59] This quotation is taken from Sam Solnick, *Poetry and the Anthropocene*, page 148. The italics are my emphasis. It has not been possible to view the original: Solnick has obtained it from the Olson archives in the USA. Prynne, J.H. 1964. 'Letter to Charles Olson.' 21 January 1964. Series 2 box 206. Charles Olson Research Collection, Archives and Special Collections at the Thomas J Dodd Research Centre, University of Connecticut Libraries.

> ecosystems, much less in claiming that they are similar, or even identical.'[60]

Phillips concludes that 'Unfortunately this view, far from being an eccentric one, is prevalent in ecocriticism, which demonstrates the field's need for more, and more self-conscious, theoretical know-how.'[61] But to what extent is Phillips correct? At first glance there are some problematic or debatable elements to his assertions. Contemporary literary theorists might take issue with the idea of a poetic text as 'static', given that it differs on every reading according to each reader's interpretation and his or her cultural and historical milieu, and on every spoken performance as well. In other words, there may be a category error here: perhaps we should not compare an ecosystem with a poem because that is to compare whole with part; a 'poem' is one entity within a larger textual and cultural system. Simply because the critics that Phillips censures often *are* comparing part with whole that does not mean that we have to propagate this activity. Nor are ecosystems necessarily passive: these days they are generally understood to be actively self-organising systems, and operate according to a number of identifiable principles that can be gathered under the rubric of complexity theory. Ecosystems also do not 'just happen' in the sense that they are at least partly the cumulative product of individual agencies operating within them, one major example of which is human influence.

Equally, it is questionable to assert that ecosystems 'don't mean anything.' Ecosystems as they are studied by ecologists certainly do 'mean' something, if to mean something is to stand for something else or to seek to establish some sort of 'fact' or 'value', because, as previously noted, they are themselves interpretative constructs. On this basis, we are comparing one (scientific) form of representation with another (literary) form of representation. Even if 'ecosystem' is taken to mean the underlying material world rather than the concept as a way of reading or modelling what is in the world, there are millions of 'meanings' within it, at least according to biosemiotics. Nonetheless, it is apparent that Phillips's criticisms do need further exploration and may in part be valid – particularly in the case of some of the more casual or unsubstantiated examples of this trope, which are reminiscent of the questionable borrowing of scientific terms by poets that C. P. Snow identifies. At the very least, Phillips's remarks prompt further study of this recurring ecocritical tendency, rather than its outright dismissal. In order to explore Phillips's

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60 Dana Phillips, *The Truth of Ecology: Nature, Culture and Literature in America*, (Cary, NC, USA Oxford University Press, 2003), p. 141 and pp. 142-143.

61 Phillips, *The Truth of Ecology*, p. 142.

contentions further and to examine the validity of these comparisons, which I will seek to do throughout this thesis and particularly in the final sections, it will be useful first to consider some of the various possible reasons for their prevalence.

The fact that we can dismiss or attack some of the dissimilarities that Phillips identifies, and that we can assert some obvious points of correlation between texts and ecosystems, does not necessarily mean that these analogies *are* valid in all respects. In 1991 the cognitive scientist M. I. Sereno produced a rigorous critical analysis of four commonly drawn analogies between biological and cultural/linguistic evolution.[62] The four analogies that Sereno identified were: (i) species/language; (ii) organism/concept; (iii) genes/culture; and (iv) the post 1950 cell/person analogy derived from the idea of linguistic cellular codes.[63] Of these four types, Sereno concluded, only the latter was valid because only that one could be shown to map at all levels of organisation, and hence could be used to generate predictions.[64] Here, Sereno's academic background becomes apparent: in the humanities, at least, we do not only draw analogies because they allow us to generate predictions, nor do we draw them solely in order to talk about the similarities between two domains. Analogies and comparisons are also interesting in what they tell us about dissimilarity, in how they help us to correct our assumptions and revisit our ideas, and in a generative capacity. As Canguilhem pointed out in his discussion of analogies and models:

> 'A good hypothesis is not always that which leads rapidly to its own confirmation, which allows at the first attempt the description of a phenomenon in an explanatory schema. It is that which obliges the researcher, by dint of an unforeseen discord between the explanation and the description, either to correct the description or to reconstruct the schema of explanation.'[65]

It is clear that the question of why critics tend to draw these parallels and the question of their validity or value are inextricably linked. For some purposes it may matter less that a cross-domain mapping is substantially convincing in a number of particulars, and for other purposes it may be crucial. Even if our critical analogies appear specious or far-fetched, they

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62 M.I. Sereno 'Four Analogies between Biological and Cultural/Lingustic Evolution', *Journal of Theoretical Biology*, 151 (1991), pp. 467-507.

63 The poem/ecosystem comparison is closest to – but not quite the same as – the organism/concept analogy. In this thesis I will be talking about a comparison at a structural level and in terms of relations, which makes all the difference to whether or not these analogies 'work.'

64 Indeed, Sereno concluded that the other three types of analogy could be reduced to the cell/person analogy.

65 Canguilhem, p. 517.

can still open up new avenues of thinking, just as surprising metaphors, models and analogies enrich our literary subject matter (and, as it turns out, our scientific subject matter too). As the futurist Marinetti described it in his 'Technical Manifesto of Futurist Literature':

> 'Analogy is nothing more than the deep love that assembles distant, seemingly diverse and hostile things. An orchestral style, at once polychromatic, polyphonic, and polymorphous, can embrace the life of matter only by means of the most extensive analogies.'[66]

At first sight, then, there are a number of general explanations for the persistence of these comparisons. It might be that we are trying to stitch text and world ever closer together in our minds, to validate textual artefacts by reference to the material world. It may be an unconscious attempt to co-opt the perceived authority of science, using scientific and quasi-scientific ideas (such as the ecosystem) in a fairly non-rigorous attempt to illuminate something about language and thought. It could be simply that there is hermeneutic value in these comparisons, in genuinely revealing something about either textual or natural systems; drawing analogies does seem to be hardwired into our cognitive processes. There may also be some generative or creative potential in these ideas where they are employed as fairly loose metaphors, which might account for the ways in which poets such as Marcella Durand and Lyn Hejinian talk about poetry as ecosystem. Or it could be that we are just reprising the same tired old ecocritical themes over and over again in a fairly unexamined fashion, as in Phillips's view.

Depending upon the purpose of the comparison it will matter rather more or less how far the points of reference hold true across the two domains. For example, text/ecosystem comparisons might have value even where they have few points of correlation because they nonetheless generate some productive tensions in thinking about both texts and ecologies, and also remind us that the material world not only informs texts – both scientific and poetic – but is embedded within them and vice versa. I have already noted that poets (such as Marcella Durand and Lyn Hejinian) explicitly describe poems as ecosystems, and there is a related tradition of poets using these scientific ideas to enable creativity. In *The Biologist's Mistress: Rethinking Self-Organization in Art, Literature and Nature*, the novelist Victoria Alexander makes out an argument expressed in teleological terms that the *process* of literary

[66] Filippo Marinetti 'Technical Manifesto of Futurist Literature', in John Cook ed., *Poetry in Theory: An Anthology 1900 – 2000* (Massachusetts and Oxford: Blackwell Publishing, 2004), pp. 56–60, at p. 57.

creation is itself a complex system that features novelty as an emergent property.[67] By teleological, Alexander in fact means something close to the notion of autopoiesis, but she is using autopoeisis to mean self-organisation rather than self-production, an important distinction, as we shall see.

Whilst this is an interesting study, and usefully incorporates insights drawn from the American pragmatists, something that I will later argue is necessary for attempting to 'read' complexity, unfortunately Alexander's analysis does not cast any particular light on poetry as ecosystem or ecosystem as text, nor on the question of the embodiment or embeddedness of complexity in form, nor on associated notions of plasticity. What Alexander's work does do is to remind us of the regular creative exploitation of all types of metaphor, analogy and comparison. A defining quality of poetry, of course, is that it regularly exploits the generative and connotative potential of these devices. Although many experimental poets do not frequently employ metaphor, similar connections and effects can arise through the use of the surprising juxtaposition of ideas and contexts found in metonymy, disjunction, parataxis and enjambement.[68] This type of creative association, misprision or 'happy accident' exploits the incorporation of the unexpected and/or the imprecise; language broadens thought simply because of the number of both denotations and connotations that it carries, and this rich potential tends to be actively exploited by the poet (a sentiment neatly articulated by Hart Crane).[69]

There is another way of discussing some of the continuities between complexity and creativity, as we discover when we turn to the work of Durand. Durand's intriguing claim – that experimental poetry might actually utilise ecological *processes* within itself – does seem to go rather beyond the usual assertions of spatial world/text correlations; but rather than suggesting that poems actually *are* or genuinely *contain* ecologies or the types of processes we find in nature she might simply have intended a purely descriptive metaphor, mildly

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67 Victoria N. Alexander, *The Biologist's Mistress: Rethinking Self-Organization in Art, Literature and Nature* (USA: Emergent Publications, 2011).

68 Some theorists, including Barthes, have argued that what appears to be the usual denotation of a word is ultimately only the last possible connotation, which seems to establish and close the reading; this reinforces the illusion of language as transparent and natural. Vološinov argued that there is no neutral/natural denotation that is free from the evaluative factors of connotation.

69 Hart Crane commented 'I may very possibly be more interested in the so-called illogical impingements of the connotations of words on the consciousness (and their combinations and interplay in metaphor on this basis) than I am interested in the preservation of their logically rigid significations at the cost of limiting my subject matter and the perceptions involved in the poem'. Crane, Hart, A Letter to Harriet Monroe (as reprinted in Poetry, October 1926) - Crane's "Logic of Metaphor", Modern American Poetry, http://www.english.illinois.edu/MAPS/poets/a_f/crane/metaphor.htm [19 December 2011] There is, of course, a huge body of work on metaphor generally, and some would argue that all language – and by extension, thought – is essentially metaphorical.

evocative of a set of ideas that could connect text and world. In this instance the value of the comparison might lie in the connotative potential that tends to be generated by any use of metaphor, and the extent to which text and world truly correlate need not really concern us.

Using the rubric of sustainable ecological practices (for example, when Marcella Durand talks about poetry as 'recycling' or Jed Rasula writes about intertextuality as 'compost') may also be politically or ideologically 'useful' if it reinforces ethical or ecological ideas, a purpose that Phillips overlooks in his critique of the text/ecosystem parallels exercise. Again, the extent of the cross-domain mapping is not really the point. For example, Durand suggests that:

> the 'idea of equality of value [between living and non-living things] is essential for moving from the exploitativeness and inertness of traditional Nature poetry […] into the incipient and dynamic idea of poetry as ecosystem itself, instigated and animated through a […] concentration upon exterior systems,'[70]

and again:

> 'For myself the process is as such: concentration upon spaces and landscape leads to poetry; poetry leads to further concentration upon spaces and landscapes. It is my poetic ecological system – self-sustaining, linguistically self-contained, recycling and, if successful, animating both words and perception with the idea of action.'[71]

Here Durand is discussing 'poetry as ecosystem itself.' In the second passage cited above Durand describes a 'poetic ecological system' which seems to incorporate both the poem, the actual material landscape, and the act of writing, all together as one poetic ecological system that she describes as 'self-sustaining, linguistically self-contained, recycling.' Energy, we infer, is once again cycling through the textual system.

This idea of poetic 'recycling' is an example of a drawing out of the comparison that hovers somewhere between the actual and the figurative, a metaphor and at once something more than a metaphor – that is, poetry may be composed from 'found' or otherwise appropriated materials. This method has of course been widely used by experimental 20th and 21st century poets including Durand herself, as the poet and ecocritic Harriet Tarlo has discussed

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70 Durand, *Ecology of Poetry*, pp. 59-60.
71 Durand, *Ecology of Poetry*, p. 60.

in her essay 'Recycles: the Eco-Ethical Poetics of Found Text in Contemporary Poetry.'[72] For example, in the 2009 poem 'Deep Eco Pré', Durand and Darragh collaboratively recycle words and ideas from Francis Ponge's *The Making of the Pré* and Michael Zimmerman's *Contesting Earth's Future*, a book on the philosophies behind the environmentalist movement 'Deep Ecology.' Durand's recycling of pre-used materials (words, images, ideas) demonstrates the creative application of a process actually found in nature, the recycling and re-use of energy and matter being a major feature of many processes in the natural world. Not only is the structural principle of recycling here embedded in poetic form, but in a further complication the substantive content of the poem is also playing with ideas of energy transfer and use:

> and there is oil under each national park, and each tree is oily filled with oil,
> energy moves through the isolated pockets, as ego channeled through clavier,
> vertical and pared away, a giant T like an apron, changes damages, below
> low as we had enjoyed, brief pockets, a river running by[73]

Of course, the only literal part of this 'entropological' 'recycling' is the *nature* of the process itself. The textual process does clearly parallel – and may even be said to use – something like the ecological process. However, the starting materials and end results are very different, and seem only to be linked in a way that is really very loosely analogical (although Durand herself, as we have seen, seems to be making a greater claim for the connection than this). Clearly, the poetic technique has limited utility in terms of sustainable ecological practice, but it might, more broadly, be thought to encourage sustainable behaviours: Harriet Tarlo identifies in this technique an 'eco-ethical stance' embedded in poetic form that endeavours to stimulate the reader into 'understanding and action'.[74] So here, using material processes as comparators for textual ones is important for the ethical dimensions that it imports. But it is not clear that using the analogy of recycling for the poetic process adds much to our understanding of how the poem itself operates, nor does it shed any light on physical ecosystems.

In view of the later theme in this thesis of complexity theory, it is worth pointing out that Durand herself identified the purpose of the technique as resistance to the centralisation of

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72 Harriet Tarlo, 'Recycles: The Eco-Ethical Poetics of Found Text in Contemporary Poetry', *Journal of Ecocriticism*, 1 (2009), pp. 114-29.

73 Marcella Durand and Tina Darragh, *Deep Eco Pré*, (LRL E-editions, 2009).

74 Harriet Tarlo, 'Recycles: The Eco-Ethical Poetics of Found Text in Contemporary Poetry', *Journal of Ecocriticism*, 1 (2009).

the lyric subject. According to Darragh and Durand's working notes in ecopoetics, we are told that:

> 'Starting with straightforward juxtapositions of texts from both authors, Durand and Darragh would then overlap language and space out sounds […] to keep deep ecology, social ecology and ecofeminist ideas from lapsing into the logic of identity.'[75]

Moving beyond the loosely analogical use of text/ecosystem comparisons, which may happen for didactic, political, or other reasons, there are of course other possibilities. There are instances of a more sustained attempt to draw comparisons between natural and textual artefacts, in a way that takes us to the furthest reaches of the analogical exercise. A more complicated presentation of the poem as ecosystem is offered by Lyn Hejinian, with reference to her 2004 collaboration with the artist Emilie Clark, 'The Lake.'[76] This poem resulted from a week the artist and poet spent staying at Lake Wentworth, New Hampshire, during which each worked in the other's usual medium as well as her own.[77] The end result consists of a monochrome collage of photographic, watercolour, and pen and ink images, overlaid with handwritten text. In twelve illustrated pages, the poet and artist present the reader with a number of disparate phenomena – turtles and fish (chars), passions and skims, rends and emotions, girting, touchstones and clouds – that are hard to connect together in any logical fashion. These items are placed in parataxis, material items presented alongside abstractions and challenging speculations ('How does one think nonetheless emotions?'), and although broadly speaking the theme appears to be ecological in nature, there is no obvious signposting as to what the reader should make of the work. In other words, it is not clear how, or even whether, the reader should seek or interpret meaning in this work, and at first glance it seems any meaning will be at best fragmentary, and constructed mainly by the reader.

So how should we read 'The Lake'? Hejinian and Clark offer some clues. In 2001, they observed of their collaboration that:

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75 Tina Darragh and Marcella Durand 'Working Notes for Deep Eco Pré' <http://www.asu.edu/pipercwcenter/how2journal/vol_3_no_2/ecopoetics/introstatements/section1_notes.html#darraghdurand>

76 Lyn Hejinian and Emilie Clark, *The Lake* (New York: Granary Books, 2001). *The Lake* was Hejinian and Clark's second collaboration following the publication of 'The Traveler and the Hill and the Hill' in 1998.

77 http://www.granarybooks.com/books/lake/the.lake1.html

> 'In retrospect the work can be seen as a study of an ecosystem, in which the lake figures both as a literal and a metaphorical landscape. *Language and visual imagery were the ecological elements in the system of the work, as the various material forms above, around, and below the lake's surface were in that of the site. We were interested in the interrelationships, simultaneities, and the extents of layers* [my emphasis]; we were thinking about complex emotional and aesthetic terrains along with the literal one we were investigating. We imagined the lake as a site and described such a site as being constituted by all possible responses to it.'[78]

At first glance Hejinian and Clark seem to be saying that the poem is a *study* of an ecosystem: 'In retrospect the work can be seen as a study of an ecosystem, in which the lake figures both as a literal and a metaphorical landscape.' That seems to be straightforward and much as we would expect: the text represents or analyses the world, or at least the world as we understand it through the models of science such as the ecosystem; and, furthermore, the world is 'constituted' at least partly through the phenomenological experience of it and associated responses. However, Hejinian and Clark then offer the intriguing assertion that: 'Language and visual imagery were the ecological elements in the system of the work, as the various material forms above, around, and below the lake's surface were in that of the site.' The work is a 'system', a type of ecosystem, whose ecological 'elements' are language and visual imagery. In other words, Hejinian and Clark are conceptualizing the poem itself as if it is an ecosystem. But why might they do so?

The *Stanford Encyclopedia of Philosophy* lists a number of functions, in more detail and a broader context than the philosophy of science examples I mentioned in the previous section, for the use of analogy and analogical reasoning, including the explanatory, the heuristic, and the justificatory – that is, citing similarity between two systems in order to support the conclusion that some further similarity exists.[79] Both basic analogy and conceptual metaphor (as described by Lakoff and Johnson) work by suggesting that the source domain and the target domain are similar in certain respects and that they can be mapped to one another, just

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78 Lyn Hejinian and Emilie Clark, '"The Lake: A Collaboration by Lyn Hejinian and Emilie Clark" Working Note', in *How2,* (2001).

79 'Analogy', Stanford Encylopedia of Philosophy. Accessed online at https://plato.stanford.edu/entries/reasoning-analogy/ [Accessed 1 September 2015].

as Mary Hesse's scientific models and analogies are based upon observable similarities.[80] In the case of Hejinian and Clark's suggestion that a poem is an ecosystem, the source domain would be the ecosystem, and the target would be the poem. Where ecocritics or poets are using straightforward analogies or metaphors of this type and not extending them very far, the implication is merely that we can better understand certain features of the poem because we have compared them with certain features of an ecosystem. But that analogy or metaphor would morph into an inductive argument when it is used to suggest that because the source domain (the ecosystem) has some further feature that is not listed in the initial comparison, the target domain, or poem, might have it as well.[81] That is, the comparison would have some predictive force, as with the types of neutral analogy that Hesse described, and the thrust of Sereno's analysis. Even where the comparison is not deliberately extended into an argument – even where a poet or ecocritic is simply calling attention to certain similarities of feature between world and text – it is possible that that third stage can happen by implication and a plethora of denotative and connotative ideas from the source domain (the ecosystem) may implicitly be imported into the target domain (the poem), in line with Fox Keller and Kay's arguments. Indeed, arguably this can even happen the other way round, which rather complicates our literary critical notions of ecosystems.

Returning to Hejinian and Clark's poem/ecosystem comparison with the *Stanford Encyclopedia*'s possibilities in mind, can we identify whether their intention is explanatory, heuristic, justificatory, or something else? It seems unlikely, to start with, that Hejinian and Clark are drawing the comparison in a purely explanatory capacity. In general, conceptual metaphors and analogies that are being used for those purposes employ a more concrete or physical concept as the source in order to elucidate a more abstract concept, the target. This is not the case with Hejinian and Clark's poem/ecosystem comparison, because the ecosystem is itself an abstract idea containing, as we have seen, historical and sometimes incommensurable metaphors within itself. To call a poem an ecosystem does not concretise or stabilise our notion of a poem's operation; rather, it complicates and destabilises it. Even if Hejinian and Clark are seeking to invoke the underlying material world that the

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80 Lakoff and Johnson's insights in cognitive linguistics and metaphor arise from the idea of cognition that was pioneered by Maturana in the development of the idea of autopoiesis. The three key hallmarks of Lakoff and Johnson's work are the insights that thought is mostly unconscious, the mind is inherently embodied, and abstract concepts are largely metaphorical. Without our awareness, the cognitive unconscious shapes and structures all conscious thought. See George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago and London: University of Chicago Press, 1980) and *Philosophy in the Flesh* (New York: Basic Books, 1999).

81 An inductive argument is an argument that is intended merely to establish or increase the probability of its conclusion. In an inductive argument, the premises are intended only to be so strong that, if they were true, then it would be *unlikely* that the conclusion is false.

'ecosystem' describes, which is rather more concrete, it is no less complex and no more helpful in a descriptive sense to assist our understanding of how texts work.

If Hejinian and Clark are not invoking the ecosystem idea in order to concretise or explain the abstract idea of a poem, if they are actually offering a yet more abstract and complex source domain as a model, what could be the purpose of this? It is possible that they are using the type of analogical and metaphorical argument that operates in a justificatory and/or heuristic capacity; that is, they may be extending our ideas of how poems operate by mapping the most obviously comparable structural features of the source and target domains, and then asking us to draw our own conclusions as to what further aspects of the structural processes that we call ecosystems might be shared by the dynamics of a text.

In offering a comparison between textual and physical systems, 'The Lake' and the actual lake, Hejinian and Clark draw attention to some of the common problems that present in modelling or predicting the operation of complex or unstable systems. In particular these remarks seem to foreground the idea of 'interconnection', a key concept in ecology and a favourite, but overused, ecocritical theme. As Sam Solnick has pointed out, emphasising global interdependence leads to a failure to attend to the specificities.[82] There can be little value in reprising the idea of interconnection in a vague and generic sense, nor in talking about 'interconnectedness', the 'web' or the 'mesh', unless it reveals to us something that we did not otherwise know. And here poetry comes into its own, because what it can offer us, by way of somewhat mysterious cognitive processes, is something that has aptly been described as the materialisation of the 'underthought.'[83] That is, Hejinian and Clark's poetry articulates for us something about why and how complex interconnectedness is so difficult to understand, in either text or ecology.

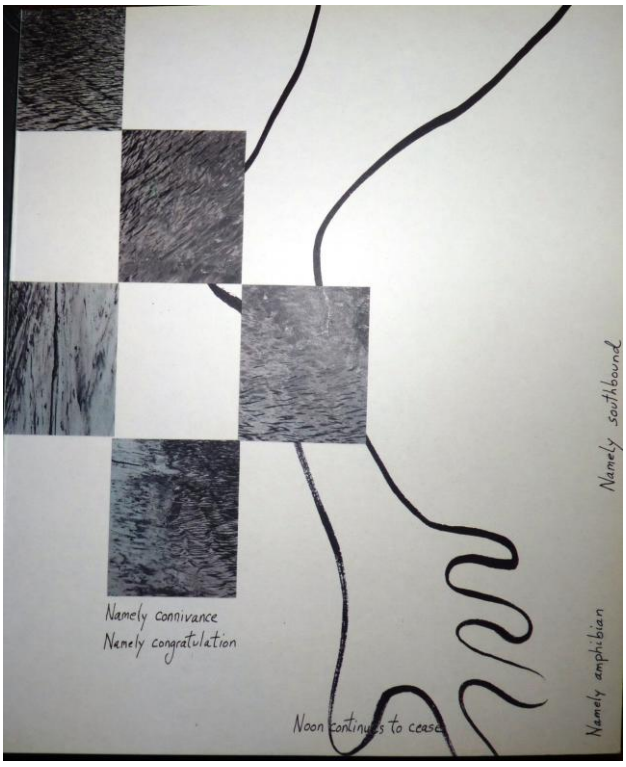
Foregrounding 'interconnections' or interdependencies means actually drawing attention to the relationships between things, to the same extent as the actual things themselves, something that is not always brought out when critics use the interconnection cliché. That is, it is a shift of focus that is important, from objects to relations-and-objects. As Morton puts it, 'since everything is interconnected, there is no definite background and therefore no

82 Solnick, p. 32.

83 Montgomery, Will 'Appropriating primal indeterminacy: language, landscape and postmodern poetics in Susan Howe's *Thorow*' *Textual Practice*, 20:4 2006, pp. 739-757, at p. 741.

definite foreground': it has the effect of radically altering our frame of reference and our notions of contextualisation.[84]

Relationships, in an ecological sense, usually come down to questions of cause and effect or modification – the impact that the existence and behaviour of one element has on one or more other elements. As I will discuss in greater detail in the section on Hejinian's poetics, she has a recurring interest in ideas of connections and relations. Hejinian and Clark's comparison of poem and ecosystem serves to remind us of the very complex and often invisible – even paradoxical or incompatible – relationships that exist within a text. Thus, the major cross-domain mapping we can detect here is the idea of a multiplicitous interconnectedness in both textual and natural systems. 'The Lake' has rather less obviously circumscribed connections and dimensions – both inter- and intra- textual – than more mainstream forms of poetry. What appear to operate as disjunctions in fact operate as sites of potential for multiple conjunctions:



Hejinian and Clark, *The Lake*[85]

It is not clear, in the example above, in what order the five phrases are 'supposed' to be read and there are a number of possible constructions that make some sort of 'sense' from a

84 Timothy Morton *The Ecological Thought* (Cambridge, MA, USA: Harvard University Press, 2010), p. 28.

85 Hejinian and Clark, *The Lake*, seventh stanza/page.

semantic point of view, as well as offering a sense of pattern in the physical dimensions of the words. One possible version would be:

Namely connivance
Namely congratulation
Noon continues to cease
Namely amphibian
Namely southbound

This gestures to a world beyond the text, to space, time, a compass direction and an implied journey, social codes and behaviours, the constant ephemeral reality of noon continuing 'to cease', to biological classifications, and so on. The repetition of 'namely' alerts us to the constructive capacity of language and taxonomy, as well as suggesting some wider categories of which these are merely examples. The artwork imports a further layer of semantic ambivalence. The black outline seems to represent either a frog's limb (namely amphibian?) or a human hand, and simultaneously to recall the outline of a lake. The drawing works as a synecdoche that invokes the human and nonhuman animals at the same time as it invokes the nonanimal (abiotic) shoreline. Here, the poem's form also itself interrogates the notions of part and whole that confound ecologists. These various interpretations call attention to our incessant search for semantic patterning in poetry of this type, as well as to our wider tendency to search for anthropocentric resemblances and mirrored likenesses at multiple levels – which we will see in many of the ecosystem's ideologies, especially those to do with development unfolding over time.

Clearly, a focus on connections in a poetic text, particularly between the component parts of language (letters, morphemes, words, phrases, lines and sentences, and their resulting semantic and affective resonances) is a staple of any poetics – as Hejinian elsewhere remarks, 'poetry is an art of linkages' – as is an evaluation of the connective and disconnective effects of recontextualising foreign materials in poetic 'recycling', but just as with ecosystems, it is difficult to articulate how these connections actually operate.[86] That is particularly the case in experimental poetry of this type, in which there is no prescribed direction of reading and the poem operates on the basis of semantic slippage and the inscription of multiple layers that are always contingently, stochastically, interacting. These texts are dynamic – we should treat them as process or system rather than as static artefact, and move beyond the attempt to read linearly.

[86] Lyn Hejinian, *The Language of Inquiry*, (Berkeley and Los Angeles, California, and London, England: University of California Press, 2000), p. 13.

‘The Lake’ engages thematically as well as formally with ideas of connections. The third page of the poem begins with the lines ‘The mud turtles, the light chars/ They are the loose parts known as passions for connections’, which seems to read more as a sentence than as two juxtaposed lines.[87] ‘They’ seems to be referring to the turtles and fish, but how the fish and turtles can be ‘known as passions for connections’ seems cryptic, even obscure, until one remembers the American pragmatist philosopher, William James, in whose work Hejinian is intensely interested, and his focus on the relations between things as the cornerstone of his philosophy of radical empiricism. Hejinian seems to be suggesting that the turtle and fish are both ‘parts’ *and* ‘connections’ and that both connections and relations are critical in determining the whole ecosystem and how we know it. Alternatively, this second line is two or more separate sentences stitched together disjunctively – ‘They are the loose parts’ and ‘known as passions for connections’, in which case Hejinian is offering us a new connection between ideas that models the complexities of parts, connections and wholes: parts can only be known *as* passions for connections, in their capacity as a joyfully interacting, multiply connected but simultaneously loose, component of a whole. We cannot ‘know’ them in any other way.

To extend this a little, we can connect the problem of myriad interconnections and resulting emergence within an ecosystem with Hejinian’s influential notion of the textual rejection of closure, which points to the rejection of the definitive authority and transmission of prescribed ideas from writer to reader, in line with some important strands of later 20th century literary theory.[88] ‘Open’ texts also implicitly reject other cultural, social, economic conventions, including the usual hierarchical privileging of subject over object (and of course ‘culture’ over ‘nature’ that, according to many ecocritics, constitute ongoing problems in our approaches to ecosystems and their nonhuman inhabitants). The ‘openness’ of these texts works because they operate, and can be read, in any one of a number of ways, as can ecosystems. It is not only ambiguous spatial placing – techniques such as parataxis and disjunction and the layering of artwork and text – that permits of textual openness but also the nature of the linguistic medium itself. The rejection of closure leads to a richer operation of emergence. It is rendered possible by the multiple instabilities, the polymorphism of language. As Hejinian remarks,

> ‘Language is qualitatively different from other artistic mediums in that it isn’t, strictly speaking, one thing, a single type of material. Language

[87] Chars are a type of freshwater trout.

[88] For an explanation of the rejection of closure see Hejinian, *The Language of Inquiry*, p.42.

> consists of a vast array of strategies and situations for discovering and making meaning. It not only exists in multitudes of context, it is multitudes of context.'[89]

Here, then, is yet another confluence between the ecosystem and textual system: a constant reciprocal contextual reframing. The lack of linearity and deprivileging of centre and hierarchy that a modern ecosystem-based model would express is also mirrored in the poetic attempt to decentre the lyric subject and excise obvious authorial intervention.

When we apply complexity theory, which as we have seen is a mainstream contemporary way of reading ecosystem dynamics, to the idea of ecological interconnections, we find that these interconnections result in local, emergent self-organisation. The manifestation of emergence is often based upon the contingent, the stochastic, and the operation of feedback. The emergent properties of a system therefore render that system 'more than the sum of its parts', because neither complex systems nor their emergent properties can be understood purely through reductionist and determinist approaches that seek to identify and understand the parts in isolation.

Following our analogical argument structure, can we postulate that emergence and self-organisation are also likely to be present within texts because of the other points of cross-domain confluence that we have identified? I think we can, and that we can characterise them as the emergence of semantic meaning and affective resonance. On the one hand, to say that a poem generates meaning or affect or an aesthetic effect or a 'poethics', to use Joan Retallack's phrase, is perhaps banal, but on the other hand using the rubric of complexity does help us to some extent, if only because of the intense focus on the multiple ways in which those connections generate their emergent properties, because it shifts our focus *onto* those connections, and also because it offers a preformed toolkit and lexicon for analysis. This can, as I will argue in the later chapters of this thesis, take us beyond other ways of analysing texts. To put it another way, it might be helpful to conceptualise the phenomenological experience of reading experimental poetry as itself emergent and autopoietic – that is, in effect, reading a poem brings about a self-producing and dynamic process in the reader's mind, with unpredictable emergent properties, which is anti-entropic in the sense that text and thought are mutually generative. This of course brings us back full circle to Gander and Kinsella and the sustainable, renewable – anti-entropic – energy of ecopoetry, ecopoetry as 'endlessly renewable form of energy.' It is here that we can perhaps

[89] *The Language of Inquiry*, p. 162.

identify one purpose of these analogies, as well as beginning to form a tentative view as to their 'value.'

To extend this reasoning a little further, into its strongest form, it may be that the text/ecosystem comparison is not merely a valid analogy, but actually expresses a true homology. In biology a 'homology' indicates a shared ancestry or common descent and – to use another perilous metaphor – it may be that we can identify a homologous relationship between texts and ecologies, or argue that texts and ecologies are in fact types of the same thing – that is, that they do not simply bear a resemblance to one another but that they are both types of complex system. Hence, a cross-domain mapping presaged upon texts and ecologies as complex systems should in theory shed light upon texts or ecosystems or on the scientific understanding of ecosystems, and allow us to extend our reasoning in either discourse. This is a question I will investigate in the final section of this thesis. Certainly Timothy Morton detects something more than mere analogy in his comparison of texts and ecologies:

> 'The further scholarship investigates life forms (ecology, evolutionary biology and microbiology) the less those forms can be said to have a single, independent and lasting identity. The further scholarship delves into texts (deconstruction) the less they too can be said to have a single, independent and lasting identity. This similarity is not simply an analogy. Lifeforms cannot be said to differ in a rigorous way from texts. [...] The difference between what counts as a mere metaphor and what counts as non-metaphorical reality collapses when thinking engages text seriously.'[90]

There are resonances here with Gregory Bateson's idea of the fundamental unity of language and biology in *An Ecology of Thought*, with an early nod to biosemiotics:

> 'the man who studies the arrangement of leaves and branches in the growth of a flowering plant may note an analogy between the formal relations between stems, leaves, and buds, and the formal relations that obtain between different sorts of words in a sentence [...] *Both grammar and biological structure are products of communicational and organisational process* [my emphasis]. The anatomy of the plant

[90] Timothy Morton, 'Ecology as Text', pp. 1-3.

> is a complex transform of genotypic instructions, and the "language" of the genes, like any other language, must of necessity have contextual structure. Moreover, in all communication, there must be a relevance between the contextual structure of the message and some structuring of the recipient. The tissues of the plant could not "read" the genotypic instructions carried on the chromosomes in every cell unless cell and tissue exist, at that given moment, in a contextual structure.'[91]

Lily Kay, presumably, would not have approved of this passage.

If poem and ecosystem are homologous, there still needs to be a degree of rigour towards our application of the ecological science, but the comparison will not necessarily fall simply because there are fewer cross-domain resemblances: we would not expect to see correlates at all levels of organisation where phenomena have a shared ancestry but no horizontal causal link. In this scenario, both poem and ecosystem operate as target domains. If this argument can be made out it suggests that the linguistic turn in the second half of the 20th century reveals more than we realised about our inhabitation of the Earth, not only in the weak sense of exposing the sublinguistic inscriptions of power/'knowledge', but in the strong sense that it illuminates the systemic imbrications that inform our very physical existence and that of our environment and our companions on the planet.

There may of course be other reasons why we are able to use ecosystems to hypothesise about texts in this way and why these comparisons seem so intuitively valid, which perhaps come down to the fact that our relationships within the world and its inhabitants are where our texts begin. Of course, Hejinian and Clark are using the ecosystem metaphor for the poem after the event – they say that 'in retrospect' 'The Lake' can be seen that way. But I think there is an implication that, at the time of writing the poem, the perceived organising structures of nature are structurally informing Hejinian's poetics. With a poem that takes the natural world as its subject matter, we can suggest that the poem provides a literary model of an actual natural 'ecosystem' (not the scientific model) and/or of our relationship with the world and our phenomenological experience of and affective responses to it. Perhaps the reason we return again and again to these parallels is that our texts do take on the structures and dynamics that we see in the world around us; it is the relationships we see around us, the

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[91] Gregory Bateson, *Steps to an Ecology of Mind: collected essays in anthropology, psychiatry, evolution and epistemology* (UK, Paladin: 1973), pp. 13-14.

links, connections and intersubjectivities, that we identify as somehow mirrored or embedded in the text, as Timothy Morton suggests, in its formal, material and affective qualities.[92] There is thus a connection here with well-rehearsed ecocritical arguments about the textual mimesis of poetry with the 'outside' world, but the poem/ecosystem comparison extends this a little into a deeply *structural* and *formal* correlation rather than one which finds resonances between the sensory qualities of language and landscape, for example. For instance, the poet Joan Retallack brings up an example of this sort of structural connectivity in talking about Juliana Spahr's work, saying that:

> 'Juliana Spahr's *things of each possible relation hashing against one another* is an instructive and moving example of an (experimental?) ecopoetics that adopts nature's manner of operation (the hashing part). Spahr says in the research/procedural notes that are part of the project, "I took an ethnobotany course because I was trying to be a better poet. I was trying to learn more about the world [...] around me."'[93]

It is worth pointing out that this also gets us past the problems that Sereno identifies with the organism/concept analogy, because once again we are talking about valid comparisons between *structures* and *relations* rather than the attributes of objects, artefacts and other discrete phenomena and part/whole confusions.

As a final suggestion, perhaps the poetic text does not only model the Earth. It also models (and interrogates) our models of the world, through content but also particularly in its form. It is important that poets and critics alike use the terminology of science, the 'ecosystem' idea, when they discuss texts. It suggests that, whether consciously or not, poetry acts as a kind of register that records and critiques not only our encounters with the Earth but also our ways of reading the Earth and those encounters. In bringing this type of analysis to bear upon poetry, we establish a greater degree of cultural connectivity between disparate discourses. An ecocritical analysis of poetry and science alongside one another can reveal cultural themes and trends that inform both discourses and hence how we inhabit the Earth.

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92 See Morton, *The Ecological Thought*, p. 11. Art, Morton contends, 'hardwires' the environment into its very form, both in the sense of the provenance of its physical materials and in the sense that reading a poem aloud 'makes you aware of the shape and size of the space around you.' See also Sherman Paul and Lawrence Buell's idea of 'adéquation' (which has its roots in Francis Ponge's work). Adéquation, as Sherman Paul initially described it, is cogently summarised by Dana Phillips in *The Truth of Ecology* as 'a variety of literary impressionism in which the meanings and the connotations of specific words and phrases is less important than the sonorous and rhythmic effects created by their arrangement relative to one another. Adéquation entails a sort of mimesis in which the imitation of the object inheres in formal qualities that cannot be detected if one focuses solely on semantics.'

93 [Palm Press, 2003, p.27.] syllable.' http://jacketmagazine.com/32/p-retallack.shtml

There is an echo here of Shelley's defence of poetry and the layered suggestion contained in the first epigraph to this introduction that poets are mirrors of shadows of futures; that is, they operate within the domain of the nebulous, the reflected, the occult, the half-glimpsed. They operate in the realm where all of our scientific and literary systems of representation take place, and where most of our thinking is done. Poetry reveals the shadowy meanings and ideas latent in language and also estranges our world. In so doing it operates as a powerful process that can show us how we inhabit the Earth.

CHAPTER 1

Succession, Superorganisms, Systems

> 'It is clear that the interpretation of the patterns of natural communities involved an element of abstraction that went beyond the evidence of field observation. The employment of the metaphors of the human community and the complex organism to describe ecological objects and patterns has been typical of the subject. To understand the development of ecological science it is necessary to understand its language and the philosophical concepts that form a deeper context of the subject and its practitioners.'
>
> Frank Benjamin Golley,
> *A History of the Ecosystem Concept in Ecology*[94]

> 'To describe a domain of reality in terms of an imaginary theoretical model is a way of seeing things differently by changing our language about the subject of an investigation. This change of language proceeds from the construction of a heuristic fiction and through the transposition of the characteristics of this heuristic fiction to reality itself.
>
> Let us apply this concept of model to metaphor. The guideline here is the relation of the two notions of heuristic fiction and the redescription that occurs through the transference of this fiction to reality. It is this double movement that we also find in metaphor, for "a memorable metaphor has the power to bring two separate domains into cognitive and emotional relation by using language directly appropriate for the one as a lens for seeing the other..." Thanks to this detour through the heuristic fiction we perceive new connections among things.'
>
> Paul Ricouer, *Interpretation Theory:*
> *Discourse and the Surplus of Meaning*[95]

1. Succession and climax

Ecological science has always struggled with its object of study. As we have seen, in addition to the problems of observation and complexity that it entails, the discipline came into being at a time when almost nothing was known about the energetics of ecosystems. For this reason, as the late American ecologist and historian of science Frank Golley pointed out in his *A History of the Ecosystem Concept in Ecology*, the initial studies were almost entirely

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94 Golley, p. 25.

95 Paul Ricouer, *Interpretation Theory: Discourse and the Surplus of Meaning* (Fort Worth, Texas, 1976), p. 67. Ricouer is quoting from Max Black.

descriptive, and it was necessary to construct a body of observations so that patterns of behaviour could be defined and then explained. As we have seen, however, the hypotheses that structured the descriptive studies tended to be statements derived from thermodynamics or ideas about how machines operate, features that result in some of the complexities and paradoxes that still inhere within the ecosystem concept.[96] In a further layer of complication, as Golley also pointed out, the subject tends to be taught to students as though it has no history, and there are few historical studies of the discipline.[97] This of course renders its ideological load yet more invisible, and is one reason why a historicist approach to the literature might deliver value: a chronological study of literary reflections of scientific currents and the prevailing zeitgeist may reveal something about how these ideas developed. That is, literature may act as a register of epistemic change.

It would not be exaggerating to say that the ecosystem idea had its very genesis in an ideological battle amongst still recognisable factions and ideas, including prescient traces of systems theory and recurrent notions of holism, with overtones of imperialism, social engineering, and racial oppression thrown in. With his first description of the 'ecosystem' in 'The Use and Abuse of Vegetational Concepts and Terms', the Oxford ecologist Arthur Tansley was explicitly disagreeing with ideas of the 'complex organism' and the 'biotic community' in four articles published by the South African plant ecologist John Phillips.[98] John Phillips's work drew on two major sources: the ideas of the South African politician and philosopher Jan Christiaan Smuts, and the work of the American ecologist Frederic Clements of the Carnegie Institute of Washington.[99] Phillips's conclusion that a biological 'community' was in many respects 'more than the mere sum of its parts' owed a great deal to his reading of Smuts's holistic philosophy, as Phillips explicitly stated:

> 'In accordance with the holistic concept of Smuts [...] the biotic community is something more than the mere sum of its parts: it possesses a special identity - it is indeed a mass-entity with a destiny peculiar to itself.'[100]

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96 Golley, p. 82.

97 Golley, p. xii.

98 For my purposes the first of these four articles is the salient one: Phillips, John 'The Biotic Community', *Journal of Ecology* 1931, 19: pp.1-24.

99 Frederic Clements *Plant Succession: An Analysis of the Development of Vegetation* (Washington, USA: Carnegie Institute of Washington, 1916), and *Plant Indicators: The Relation of Plant Communities to Process and Practice* (Washington, USA: Carnegie Institute of Washington, 1920).

100 Phillips, John, pp. 20.

Smuts, perhaps paradoxically for an advocate of holism, was in favour of racial segregation, and Phillips's own views were no more palatable.[101]

Phillips's other key influence, the ecologist Clements, had conceptualised groups of individual organisms in a single site as though each group constituted a complex organism undergoing cycles of birth, growth and development, or succession:

> 'The essential nature of succession is indicated by its name. It is a series of invasions, a sequence of plant communities marked by the change from lower to higher life forms. […] Succession must then be regarded as the development or life history of the climax formation. It is the basic organic process of vegetation, which results in the adult or final form of this complex organism. All the stages which precede the climax are stages of growth. […] Moreover, just as the adult plant repeats its development, i.e., reproduces itself, whenever conditions permit, so also does the climax formation. The parallel may be extended much further. The flowering plant may repeat itself completely, may undergo primary reproduction from an initial embryonic cell, or the reproduction may be secondary or partial from a shoot. In like fashion, a climax formation may repeat every one of its essential stages of growth in a primary area, or it may reproduce itself only in its later stages, as in secondary areas. In short, the process of organic development is essentially alike for the individual and the community.'[102]

It is worth noting that not all ecologists agreed with Clements's ideas. Henry Gleason, for example, took issue in 1926 with the idea of the complex organism and the recapitulation of plant ontogeny and phylogeny that Clements had proposed, proposing a more complex and less deterministic version based on the operation of chance.

In line with Clements's ideas, Phillips concluded that ecological succession always results from biotic actions on the environment and that it is always progressive, converging towards a stable endpoint known as the climax. Drawing further on Clements, Phillips suggested that a practical way to view the 'biotic community' was 'as a complex organism' (which

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101 Phillips ultimately became a leading proponent of 'racial ecology' and eugenics in South Africa. See Anker, p. 123.

102 Frederic Clements *Plant Succession: An Analysis of the Development of Vegetation* (Washington, USA: Carnegie Institute of Washington, 1916), p. 6.

subsequently became known as a 'superorganism').[103] As the contemporary philosopher of ecology Arnold Van der Valk describes Clements's climax formation:

> 'A climax formation has both an ontogeny and phylogeny just like an individual plant. Like the ontogeny of a plant, succession is directional and irreversible (progressive in Clements's words). Nevertheless, Clements also realised that succession was much more "complex and obscure" than the development of an individual plant and his descriptions of specific vegetation changes are often highly mechanistic. In short, Clements's novel hypothesis is that a climax formation is a "super-organism" and that its ontogeny is the result of succession.'[104]

In his book *Imperial Ecology* (2001), the historian of ecology Peder Anker frames the debate between Phillips (drawing on Smuts's ideas), Clements, and Tansley in social, political, and ideological terms.[105] A third influential faction was the Chicago school of ecology, which sought to establish a nonaggressive ecology in tune with democratic ideas of cooperation. This was not simply a clash between South African holists and Oxford 'mechanists' (reductionists), nor even the clash between idealism and materialism, but between divergent political and ideological approaches to the structure of society itself, a clash that inhered in ostensibly innocuous terms such as 'community' and 'system.'

It is worth pausing to reflect upon some of the terms that Phillips's work employs, because they were problematic when Phillips used them and they continue to be so now. Firstly, the metaphor of a 'community' for aspects of the natural world was already established at the time that Phillips was writing. However, its use is problematic in any ecological context for several reasons, not least for its anthropocentrism and because this type of thinking suggests a level of abstraction that bears a limited degree of relation to observed phenomena: ecological systems do not behave as 'communities.' Moreover, at times Phillips was using the concept of the 'biotic community' in a particularly dubious way in order to talk about administrative relations in Tanganyika. The most significant of his four articles, 'The Biotic Community' published in 1931, opens by discussing whether animals and plants might

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103 Phillips, John, p. 23.

104 Arnold G. Van der Valk, 'Origins and Development of Ecology', in *Philosophy of Ecology*, ed. Kevin DeLaplante, Bryson Brown, and Kent A. Peacock (Oxford, UK and Mass., USA: North Holland (Elsevier), 2011), pp. 25-48 at p. 34.

105 Anker, Peder *Imperial Ecology: Environmental Order in the British Empire 1895-1945* (Cambridge, Massachusetts: Harvard University Press, 2001). Chapter 4, 'Holism and the Ecosystem Controversy' pp. 118-156, is of particular relevance for the purposes of this project.

together form a single 'community', but subsequently moves on to discuss the tsetse fly problem that his research addressed (research that he had elsewhere described as being in part for the benefit of those 'Administrative Officers responsible for the direction and control of native populations').[106]

Plants, animals, black populations and white 'officers' were all constituent parts of Phillips's biotic community as he described it in the four articles and throughout his tsetse fly research, but it is clear that in his view not all parties within that community were of equal stature or aptitude. In a particularly patronising passage in his 1930 article 'Some Important Vegetation Communities in the Central Province of Tanganyika Territory (Formerly German East Africa): A Preliminary Account,' Phillips wrote that:

> 'The native is responsible for wide-spread erosion of the soils and consequent impoverishment of the areas cleared. On account of his endeavouring to graze over-large herds of cattle upon the poor grass provided by the cleared islands in the often Tsetse-fly infested woodland, he brings about not only rapid deterioration in the pasture but also erosion and general wastage of the soil.'[107]

This was a biotic community that contained hierarchies of value, one in which the 'native' element, as Phillips saw it, needed as much management and oversight as the plants and the tsetse fly.

In a letter to Smuts in 1929, Phillips made his extension of ecological ideas into political and ideological spheres quite explicit, asking Smuts whether – as a statesman – he had been impressed,

> 'with the possibilities of applying ecological concepts – and perhaps methods – to the study of those grand subjects, human endeavour, human experience, human response, and human politics[?] Even in my own humble sphere I find the adoption of the ecological "turn of

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106 John Phillips 'Some Important Vegetation Communities in the Central Province of Tanganyika Territory (Formerly German East Africa): A Preliminary Account' *Journal of Ecology*, vol. 18, no. 2, 1930, pp. 193–234 at p. 193. See also Anker, p. 121, In an interesting twist, given the emphasis in this thesis on the links between poetry, philosophy and science, according to Anker, Phillips's 'biotic community', as derived from Smuts' holism and ideas of the harmony of nature, grew directly from Smuts' analysis of 'personality' described in his study of Walt Whitman (published posthumously in 1973) which was to become the cornerstone of his holistic philosophy, and was coined in order to contribute to a policy of trusteeship (Anker, p. 121). See also Jan C. Smuts *Walt Whitman: a Study in the Evolution of Personality* (USA: Wayne State University Press, 1973).

107 Phillips, ''Some Important Vegetation Communities', p. 230.

> mind" as regards those with whom I live and labour, pregnant with great possibilities.'[108]

The dangers of this instrumentalist approach to ecological 'science' and its concepts are readily apparent, particularly given Phillips's prejudiced outlook. However, what the use of the word 'community' did do was to move the focus of ecology away from the individual and onto what we would now call the system, although the subsequent development of the idea of the complex organism sat in a somewhat uneasy relationship with this focus.

The philosopher of ecology Christopher Eliot describes an additional issue with the 'community' metaphor in that communities are collections that lack obvious boundaries or stable memberships, which, in his words, quite possibly 'do not exist at all'.[109] This problem prefigures some of the problems of the subsequent ecosystem idea and indeed any other attempt to study collections of biological organisms.

Additionally, the community, succession, and the superorganism are all inherently anthropocentric in derivation. The most immediately preceding use of the 'complex organism' idea came from outside ecology, in the work of the sociologist Herbert Spencer who at the turn of the 20th century proposed the concept, quite explicitly as an analogy that was drawn from organic systems and could be applied to societies, but the related idea of the superorganism has an even longer heritage, deriving from the work of the geologist James Hutton in 1785 and, in its original application, applying to the whole Earth, in a way that anticipates the Gaia hypothesis.[110] Spencer's use of the term was subsequently picked up by the biologist William Morton Wheeler in an article on the ant colony as organism, before finding its way into Clements's and Phillips's work (possibly by way of the sociologist E.A. Ross, whose work was particularly influential for Clements).[111] In its original Spencerian appearance it could be used to justify aspects of human society or proposed reform, and in its application from Hutton it gave rise to an entire methodology for studying the Earth, which he called geophysiology.

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108 Phillips to Smuts, June 13 1929, Vol 32, Folio 165, CUL, quoted in Anker, *Imperial Ecology* at p. 121. It has not been possible to view the original of this letter.

109 Christopher Eliot 'The legend of order and chaos: communities and early community ecology' in *Philosophy of Ecology*, ed. DeLaplante, Brown, andPeacock, pp. 49-107 at p. 49.

110 Herbert Spencer, *Principles of Sociology* (New York: D. Appleton & Company 1898), Vol 1, Part 2, Chapter II. James Hutton *Theory of the Earth with proofs and illustrations* (Edinburgh: Creech, 1789), Vol. 1.

111 See Diane M. Rodgers, *Debugging the Link between Social Theory and Social Insects* (Baton Rouge, Louisiana: Louisiana State University Press, 2008).

In the preface to his book *The Ecology of Modernism*, the ecocritic Joshua Schuster briefly discusses Clements, predominantly with reference to his development of the 'quadrat', a square randomly placed in the landscape to delineate the borders of an ecological study. Unfortunately Schuster does not analyse Clements's thinking in detail, because his purpose is to use the quadrat as a metaphor for the framing of ecology's growing self-awareness as a problem of modernity, as an instrument that is both subjective and arbitrary, rather than to explore the history of ecology. However, Schuster does make the interesting (although not evidenced) suggestion that Clements based much of the conceptual framework for succession on civilisational theories of human development and capitalist theories of economic progress through competition because, as Schuster puts it, 'Clements feared a kind of anarchy of ecology, worried there would be no apparent order of ecological events.'[112]

If we bring Mary Hesse's ideas into play here, it can be seen that Clements's strategy was a long way from basing his model on observable aspects of similarity and indeed closer to the notion of negative analogy. This resulted in a number of further problems: for example, it is problematic to think in terms of succession or development of ecosystems, both of which imply some end goal or purpose or natural cycle to the change that takes place over time, in particular because they suggest a teleological progression to a stable end state that does not, we now know, seem to accord with reality. More broadly, it is also problematic to conceptualise change over time in an ecosystem by way of a metaphor drawn from the development of the organism, which was itself and remains incompletely understood. Again, this speaks to our recurrent tendency towards anthropocentrism. A further and equally problematic corollary of the climax idea (particularly when coupled with Tansley's later concept of dynamic equilibrium) is the persistence of narratives of equilibrium and homeostasis throughout the 20th century. These ideas perhaps had particular traction because 'equilibrium' dovetails with ubiquitous and idealised myths about the 'balance of nature' that stretch back to the Greeks, and which became yet more entrenched with the work of Linnaeus.

In *The Ecology of Modernism*, Joshua Schuster identifies the opening of William Carlos Williams's 'Spring and All' as an exploration of the notion of succession.[113] Schuster's theory is that Williams was aware of Clements's theory of succession and the practice of

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112 Schuster, Joshua *The Ecology of Modernism: American Environments and Avant-Garde Poetics* (USA: University of Alabama Press, 2015), at p. vii and ix.

113 Schuster, *The Ecology Of Modernism*, p. 2. William Carlos Williams *The Collected Poems of William Carlos Williams* Vol. 1 1909-1939 ed. A Walton Litz and Christopher MacGowan (New York: New Directions,1986), p. 178.

removing all living matter from within a quadrat in order to demonstrate that it regenerated to a climax state according to the principles of succession. Schuster argues that because William's poem opens after life has been wiped out leaving the 'world without us' within which this poetic regeneration occurs, Williams is transplanting the plant succession model to poetry, which is an original take on the more conventional 'existing winter/ imagined spring' reading of the text. 'They' who 'enter the new world naked,/ cold, uncertain of all,/ save that they enter' are plants, according to Schuster, engaged in the process of succession towards a climax state. Schuster's is a fascinating approach and it is unfortunate for my purposes that he does not take this part of his analysis any further. Indeed, it is not clear that Schuster *could* take this part of his analysis any further, because any attempt to provide close evidence of this hypothesis from the text reveals it for what it is, a fairly loose example of a comparison between text and ecology (this is not to criticise Schuster, whose purpose is different from mine).

Something that does add an extra dimension that is not found in most ecocriticism is Schuster's implicit suggestion that Williams acknowledges the role of the ecologist and the model in mediating our experience of the natural world. If we do seek to extend Schuster's reading, it is clear that we must be careful to distinguish between intention and interpretation: it seems unlikely that Williams actually intended his poem to function (by means of poem as microcosm or poem as model), as a critique of science. Indeed, in the absence of any evidence, it seems unlikely that Williams *intended* to talk about succession at all. In view of Schuster's assertion that Williams was aware of Clements's theory of succession, Schuster seems to be coming close to the suggestion in the introduction to this thesis that we might read poetry as models of other types of models; that is, that Williams, whether consciously or not, imported the idea of succession into his work in a formal sense, or, as Schuster describes it, 'translates' it from one discourse to another. However, we could equally read it that Williams is modelling the longer established views of the 'balance of nature', within which the idea of succession sits, rather than the specific science of his time.

We could also read the poem as an imaginary modelling of the apocalypse caused by science or the intervention of mankind that will nonetheless be overcome and returned to a stable state by nature, but it is clear that this would simply be an interpretation of the text, and a perfectly reasonable one, if we accept the premise that the poem could be read as a depiction of plant succession. Unfortunately its usefulness stops there for the purposes of this thesis – in revealing something about our *contemporary* notions of science and climate change. In other words, 'Spring and All' does not reveal an overt contemporaneous dialogic

engagement between poets and scientists, nor any attempt on Williams's part to interrogate the science of that period. At best there is a suggestion of a subconscious importing of scientific ideas into the poetry, and importing them wholesale rather than critically. We cannot even use this interpretation as a model to topple or critique the theory of succession (in accordance with the second 'limb' of this thesis), because on this reading it doesn't; it endorses it. Similarly, because Williams's poem features a lyric subject of some kind, in the sense that the narrative is focalised, we cannot even excise the presence of the human from this model of the landscape, and read it as a prescient take on the contemporary anxiety that succession may operate to remove us from the landscape and return it to a stable state posthumanity.

Another problem with succession is that it is difficult to measure or model. In fact, theories of succession relied heavily upon the imaginative acts of early ecologists. In his book *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology*, the historian of science Robert Kohler sets out a description of physiographic ecology, the study of places where records of change or, as he puts it, 'nature's experiments' have been preserved. Instead of providing what Kohler terms an 'illegible palimpsest', in which the record of one stage obscures earlier records,

> 'the whole process of succession or evolution is inscribed legibly upon the landscape, as the process of a laboratory experiment is inscribed on a scroll of graph paper by recording instruments. [...] When ecologists read a place in this way they transform space into time, reading a vertical sequence in time from a horizontal sequence in space.'[114]

In effect, early ecologists could imagine 'places moving fast-forward through time', not in order to 'reconstruct actual histories' but to use an ideal history in order to reveal the principles of succession.[115] The active use of imagination places this practice counter to usual scientific principles of objectivity and aligns it with art.[116] In fact, Kohler's language in the extract above explicitly recalls creative acts of representation, with its references to

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114 Kohler, *Landscapes and Labscapes*, p. 230. We should note that here Kohler is using 'succession' in a more modern sense, not to imply a teleological progression to a stable and state, but simply to mean changes over time in the composition or structure of an ecological system.

115 Kohler, *Landscapes and Labscapes*, pp. 238 and 240. Kohler gives an overview of the work of Cowles and Shelford at the turn of the century.

116 As Daston and Galison (whose work will be discussed later in this thesis) might put it, this has something in common with 'trained judgment', an exercise that is a little way away from full objectivity in scientific observation.

language, inscription, and the filmic idea of fast forwarding. This imaginative act was also foregrounded in Clements's description of the sequential stages of succession as giving:

> 'a picture of the life movement of a forest much as the individual films [i.e., frames] give motion in a moving picture.'[117]

We could read the British poet Geraldine Monk's 'palimpsestus' as an act of physiographic ecology embedded in poetic form, an envisaged engagement with the landscape over time that is commensurate with the imagined 'fast-forwarding' practices described by Kohler to reveal succession. Dimensionally speaking, in an act akin to the imaginative space-to-time conversion of physiographic ecology, the space on the page is also translated into both 'textual' and ecological time: into the physical time of the reader's reading but also into a depiction of succession and the integration of species through time. In this case, though, the climax is satirised as a mere stumbling survival, and the evolution of humanity that is revealed is one of despair. The topographical spread of the page itself, as the textual landscape, reflects but also replaces the real landscape:

> ... perpetual
> dreamdrip-backdrop
> pulling centuries
> deep
> crush and spurt of
> wide-open (or)
> and
> so on
> ting (or)
> jang of nerve cords wend-
> quiet raving of.
> desires.
> fret of sad saltless. days.
> word-wars. despair of.
> displacement. of stagnation.
> (or) bounds of sassy-hugs.
> letter-love.

[117] Frederick Clements 'Plant formations and forest types' *Proceedings of the Society of American Foresters* 4 (1909), pp. 50-63, at p. 51, quoted in Kohler at p. 240. It has not been possible to obtain a copy of Clements's article.

daffy-mads.
beamers and so forth
so on
in perpetuity…
(STUMBLING SURVIVAL)[118]

Whilst the idea of succession is now treated more warily by many ecologists it nonetheless recurs in popular science. The idea of the stable state climax that results from this progressive succession and its underlying theme of stability also continued to resurface throughout the century in both ecology and beyond.[119] In part this was because Sir Arthur Tansley, who will be discussed in the next section, indirectly reinforced these ideas through the powerful (although now largely discredited) diversity/stability hypothesis, which suggested that the more diverse an ecosystem was, the greater its stability. Later ecologists in America such as Eugene Odum, who will also be discussed in subsequent chapters, used central ideas of stability and homeostasis in their work as well. In Odum's case this was largely derived from his reliance on a cybernetic model, as we shall see. Narratives of diversity and stability tend to be attractive, especially in a post-war period, and they speak to the old notion of the balance of nature. I use the word narrative deliberately; these ideas suggest an inherent tendency towards the emergence of order from disorder. This means that they are not especially challenging in an ideological sense, and hence are more likely to be accepted.

Notions of stability, diversity, and climax can even be employed in the service of an environmentalist politics. It is perhaps for this reason that they were co-opted by the American poet Gary Snyder, a poet who has been extensively studied with particular reference to his attitude towards the environment. In the 1970s Snyder made use of a somewhat updated version of the climax community idea as an analogy both for an enlightened mind and heart, and for human societies, which seems to return the metaphor, somewhat altered, to its anthropocentric source.[120] It is not surprising that Snyder turned his

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118 Geraldine Monk, 'palimspestus' *Conductors of Chaos*, ed. Iain Sinclair (London: Macmillan, 1996), p. 279.

119 For example, Wikipedia states that the study of succession, (which is described as the 'process of change in the species structure of an ecological community over time' and which 'develops through increasing complexity until it becomes stable or self-perpetuating as a climax community') apparently 'remains at the core of ecological science'. See Succession', https://en.wikipedia.org/wiki/Ecological_succession, accessed 1 August 2017.

120 Similarly, the 'climax community' is invoked, in a doubling back of the metaphor to describe a human community, in Paul Breslow's 1970 short story 'Honey Bee' published in *New Directions*. Paul Breslow, 'Honey Bee' *New Directions in Poetry and Prose* 22, ed. J. Laughlin (USA: New Directions,

mind to these questions, given his interest in anthropology, his philosophies of deep ecology and Buddhism, his reading of Odum's ecology, and his association with the Beat poets and the San Francisco Renaissance, nor is it surprising that this set of disparate ideas should jostle each other somewhat uneasily in much of his poetry (the work of Eugene Odum and Gary Snyder will also be explored further in the next two chapters respectively).

In 'The East West interview' of 1977, published in *The Real Work*, Snyder described the climax condition as an optimum condition of maturity, diversity and stability.[121] Snyder's idea of the climax condition incorporates aspects of Clements's and Phillips's thinking and is also heavily dependent upon the work of the American ecologist Eugene Odum. The idea of equilibrium significantly informed the homeostatic model of Odum, which became dominant in America in the later part of the 20th century, further supporting the narrative of 'stability' within the mature climax.

Snyder's interview explicitly described the (now largely discredited) stability/diversity hypothesis, which suggests that the greater the diversity of a living system, the greater its stability. Snyder's tone of conviction suggests that he was not aware of work from the end of the 1960s onwards that challenged this hypothesis; not only that, but he stretches the concept in an extraordinary way. He begins by suggesting that 'Certain human societies have demonstrated the capacity to become mature in the same way', adding the somewhat questionable rider that 'the only societies that mature are primitive societies', and concluding that 'civilisation is a new kind of system rather than an old or mature one.' It is noteworthy that once again – even in the hands of an ecological poet – anthropocentric overtones predominate, and the accuracy of the model is not questioned but rather brought into play to support a particular political stance.

In a related spirit of social commentary, in his 1969 ecology paper 'The Strategy of Ecosystem Development', Eugene Odum compared the development of a nation with that of an ecosystem. Odum made a promising start by announcing that 'ecological succession involves the development of ecosystems; it has many parallels in the developmental biology of organisms, and also in the development of human society.'[122] As we have seen, narratives that had been applied to the natural world by Odum and earlier scientists, such as succession,

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1970), pp. 139-149. Breslow may have been drawing on Phillips's work on the honey bee in 'The Biotic Community.'

121 Gary Snyder *The Real Work: Interviews and Talks 1964-1979*, edited by W.S. McLean (New York: New Directions, 1980), pp. 116-117.

122 Eugene Odum 'The Strategy of Ecosystem Development' *Science* Vol. 164, No. 3877 (18 April 1969), pp. 262-270, at p. 262.

were already problematic, and in bringing these to bear on social systems through the lens of the ecosystem Odum was within a long tradition of hyperextending his scientific authority.

In his paper, Odum characterised succession as an orderly process of community development that is reasonably directional and predictable, results from the modification of the environment by the community, and culminates in a stable ecosystem in which 'maximum biomass (or high information content) and symbiotic function between organisms are maintained per unit of available energy flow.' There is a great deal to remark upon here. The implicit equation of biomass with high information is both a clear marker of cybernetics thinking, to which I will return, and also highly questionable. There are recurring ideas of symbiosis and homeostasis: Odum's is an ordered, symmetrical, well-regulated world within which energy efficiency is the defining factor – another problematic idea, as we shall see in the next section. One of the effects of this paper is to demonstrate the perils of following analogy to the bitter end: Odum's use of the succession idea (based on the development of an organism, as we have seen), leads him to speculate whether an ecosystem, in effect, enters old age. Unsurprisingly, this is not a question that he is in a position to answer.

Warming to his theme, Odum continued 'In a word, the "strategy" of succession as a short term process is basically the same as the "strategy" of long-term evolutionary development of the biosphere – namely, increased control of, or homeostasis with, the physical environment [...].'[123] That long-term evolutionary development might have a "strategy", even one in scare quotes, would be news to most contemporary ecologists, who would probably view evolution as the mechanism of an adaptive response to a fluctuating environment rather than anything with a teleological progression. That this model should then be applied to America is even more surprising, as is the implication that US has further to go before reaching maximum diversity/ stability. 'It goes without saying,' Odum concludes, 'that the tabular model for ecosystem development that I have presented here has many parallels in the development of human society.' It is not simply that societies and ecosystems are alike already; 'man as a species' is exhorted to find a strategy, to become like a mature ecosystem. In Odum's work, systemic maturity and symbiosis are equated with phenomena as disparate as law and order, birth control and recycling.[124] In a further twist, Gary Snyder picks up the analogy at the end of *Turtle Island* in 'Energy is Eternal Delight' and pays it forward yet again, remarking that Odum has pointed out that 'the United States

123 Odum, 'The Strategy', p. 262.
124 Odum, 'The Strategy', p. 269.

has the character of a young ecosystem', again illustrating the transverse passage of ideas between science and other discourses.[125]

As late as 1995, Snyder was still peddling this take on the climax idea, employing it in support of an overtly political outlook. In *A Place in Space* he amalgamated theories of place and space with his scientific reading to talk about the climax in terms of increasing 'the diversity and stability of local, national, and regional ecosystems even, if need be, at the expense of the complexity and interdependence of international worldwide organizations.' According to Snyder, just as environments move toward climax, which he still defines as maximum diversity and maximum stability in a natural system, the 'primary experiencing' of nature in art reaches an ideal 'climax' condition in 'cultural diversity.'[126] Here again Snyder explicitly refers to Eugene Odum in making the same argument that 'Now, in Dr. Eugene Odum's terms, what we call civilization is an early succession phase', whereas 'what we call the primitive is a mature system with deep capacities for stability and protection built into it', an argument that is questionable for reasons that extend beyond its employment of pre-paradigm shift science.[127]

In the text of 'Poetry, Community & Climax', also published in *The Real Work,* Snyder revisits the climax idea from a different angle, but it is still presented as something with considerable stability that 'holds much energy in its web.' Although the political thrust of his essay relates to physical recycling, Snyder again cannot resist the temptation to apply quasi-ecological ideas to elucidate something about human systems (a tendency to which many of us, whether critic or poet, can relate):

> 'I would then suggest: as climax forest is to biome, so "enlightened mind" is to daily ego mind, and art to the recycling of neglected inner potential. When we deepen or enrich ourselves, looking within, understanding ourselves, we come closer to being like a climax system. [...] Art is an assimilator of unfelt experience, perception, sensation, and memory for the whole society. When all that compost of feeling and thinking comes back to us then, it comes not as a flower, but – to complete the metaphor – as a mushroom. [...] "Fruiting" – at that point – is the completion of the work of the poet, and the point where the

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125 Gary Snyder, "Energy is Eternal Delight", *Turtle Island* (USA; New Directions, 1974), p. 103. I am indebted to Peter Middleton's unpublished article 'Gary Snyder and Ecology' for drawing my attention to this use of the analogy.

126 Gary Snyder *A Place in Space: Ethics, Aesthetics And Watersheds* (Washington, DC: Counterpoint, 1995), p. 137.

127 Gary Snyder *A Place in Space*, p.138.

> artist or mystic re-enters the cycle: gives what she or he has done as nourishment, and as spore or seed spreads the "thought of enlightenment," reaching into personal depths for nutrients hidden there, back to the community. The community and its poetry are not two.'[128]

Here, Snyder's use of the climax concept to suggest that enlightenment is the stable end state (climax) resulting from the self-examination of the ego might be considered optimistic by today's psychologists; his further suggestion that art is the ultimate result of recycling resonates with Durand's poetic recycling, with the modernist collage of 20th century art and literature, with Rasula's compost, with systems theory, and so on, and as such would probably fly under the radar of much contemporary criticism, despite its overly idyllic tone which in part derives from the initial choice of metaphor.

Yet another instance of Snyder's fascination with the notion of the climax is apparent in the poem entitled 'Toward Climax' in the penultimate section of *Turtle Island*.[129] This poem satirically tracks the evolution of humanity from its early mammalian beginnings, through 'brain-size blossoming' and the development of language in which 'formal complex grammars transect/ inner structures & the daily world –' and on to the very apogee of civilisation with logging songs and the 'harvesting' of children in the Vietnam War, the climax. In a visual pun the word 'climax' is the last word of this poem, following the formal unrolling of evolution through the body of the text. 'Toward Climax' is also interesting for its interrogation of notions of nets, knots, boundaries, detritus and its wholesale appropriation of text from an ecology book: 'delayed and complex ways / to pass the food through webs.' Here again we can detect the influence of Odum and earlier ecologists with their focus on trophic dynamics. Once again Snyder oscillates between the lexicon of science and that of spirituality, placing them in dialogic engagement with one another. In the next stanza Snyder calls on the reader to draw on the mind's 'stored richness', also figured as 'detritus pathways', or, as we might put it, the recycling of energy through compost. This poem directly mirrors Snyder's thinking in 'Poetry, Community & Climax' and once again appears to be uncritical of Odum's ideas, although polemical in its denunciation of contemporary politics.

Elsewhere, in Snyder's poem 'For All', the ecosystem makes an appearance in its most diverse, and, presumably, stable climatic state:

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128 Snyder, *The Real Work* pp. 173-174.
129 Snyder 'Toward Climax' *Turtle Island* pp. 82-85.

I pledge allegiance

I pledge allegiance to the soil
of Turtle Island,
and to the beings who thereon dwell
one ecosystem
in diversity
under the sun
With joyful interpenetration for all.'[130]

Here, the straightforward language and form of the poem underscore its political, philosophical, and sexual undertones but engender a lingering sense of unease by way of their overstatement. The playfulness of Snyder's appropriation of scientific ideas is also apparent in 'Little Songs for Gaia', in which the manzanita (a Californian shrub that is related to the beerberry, which Snyder also wrote about in *Turtle Island*) undergoes an unexpected personification even as it offers shade:

'the manzanita succession story –

Shady lady,
makes the boys
turn gray'[131]

Snyder's appropriation of scientific ideas and his juxtaposition of them with ideas drawn from other discourses is an interesting example of poetry recording scientific and cultural change. What his poetry does not seem to do is to interrogate or critique the science, even in a formal sense and given these ideas are implicitly placed in comparison with other ideas. Unlike later poets who bring a more critical approach to bear to science, in fact Snyder takes an instrumentalist approach to the ecosystem model, just as Odum did, using it for wider purposes, but failing to analyse the problematic ideas within it. This may be because of his chronological moment, or it may be because of his own attitudes to science. What his work does provide is an interesting example of how these ideas were appropriated, sometimes wholesale, from ecology to other discourses, especially when both usages were in support of a wider social or political purpose. In a further twist, Snyder's reliance on the stability/diversity hypothesis and the notion of climax and succession has been accepted equally uncritically by literary critics. In a 1975 article on Snyder's work James McClintock wrote that ecosystems operate as increasingly efficient energy processes as they achieve maturity: 'a stable ecosystem in later stages of succession has 'learned' about changes in the

130 Gary Snyder 'For All' Accessed online at http://www.english.illinois.edu/maps/poets/s_z/snyder/onlinepoems.htm

131 Gary Snyder 'Little Songs for Gaia' *Axe Handles* (Washington, DC: Shoemaker & Hoard, 1983), pp. 47-59 at p. 50.

environment and can accept new information with less change and energy.' This idea recurs, again uncritically, in a 1991 article by Allan Johnston, demonstrating some of the cultural traffic that underlies the ideological heritage of these ideas.[132]

2. A note on superorganisms (I)

The superorganism idea is a similarly prevalent metaphor, both within and outside the discourse of ecology. Golley notes:

> 'That ecologists still confuse Clements's superorganism and ecosystems testifies to the persistence of concepts in ecology. In a science that is increasingly relative, faced with countless objects, and with little tested theory, these generalisations may be life rings that we hold onto in the absence of something more reliable. [...] It is ironic that the ecosystem concept has [recently] been criticised for being superorganismic when it was proposed as an alternative to the superorganism.'[133]

In line with its tangled genesis, in recent years there are three main ways in which the superorganism idea has been employed in the 20th and 21st centuries: in order to describe insect and/or human societies, occasionally with an instrumentalist bent; in a separate but related application there is also a third idea of the human body as a superorganism; and finally the superorganism is used as a metaphor for the whole earth. I will seek to trace the last two of these three categories in Chapter 3, which deals with the Gaia hypothesis, but the first is of relevance here.

In her exceptional book that traces how scientific ideas might appear in literary form, the Canadian science and literature critic Janine Rogers traces the use of the superorganism as a metaphor in Margaret Atwood's *Cat's Eye*.[134] The use of entomology in *Cat's Eye*, Rogers comments, is not merely a biographical reflection or a simple plot device, but the vehicle for a series of sophisticated metaphors for human society, psychology and art – metaphors that structure the very form of the narrative and shape the reader's engagement with the novel itself.[135] Drawing on work by Diane M. Rodgers and Charlotte Sleigh, Rogers traces the

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132 James I. McClintock 'Gary Snyder's Poetry and Ecological Science' *American Biology Teacher* 54.2 (1992): pp. 80-8 at p. 80, and Allan Johnston 'Ecology and Aesthetics: Robinson Jeffers and Gary Snyder' *Interdisciplinary Studies in Literature and Environment* 8.2 (Summer 2001), pp. 13-38 at. p. 17.

133 Golley, p. 201.

134 Janine Rogers, *Unified Fields: Science and Literary Form* (Montréal and Kingston, London, Ithaca: McGill-Queens University Press, 2014), pp. 112-140.

135 Rogers, p. 112.

ubiquity of entomological analogies in literature.[136] In Margaret Atwood's application of the superorganism idea, as with Snyder's use of the climax community, the two comparators simultaneously operate as both tenor and vehicle of the metaphor, in the sense that there is already a hidden – arguably dead – metaphor hidden within the climax community and the superorganism ideas. That is, the superorganism metaphor, incorporating as it does the communities metaphor drawn from human society and sociology, here embodies a kind of doubling in its application to ants and back again to humans.

Janine Rogers's chapter also draws our attention to Thomas's *The Lives of the Cell*, published in the 1970s, which applied the superorganism concept to language itself, suggesting that the development of language is akin to the development of a hill or hive achieved through the collective intelligence of social insects.[137] Whilst an analysis of this idea is outside the scope of this thesis, particularly in view of Rogers's thorough description of it, it is worth noting the similarity of this approach to that of other linguists who use metaphors drawn from physics or biology to describe the operations of language (for example, Roman Jakobson's ideas based on genetics, and Paul Cilliers, whose work I will explore later, as well as biosemioticians conceptualisation of language as one signalling system among many found in the natural world).

The biologist E.O. Wilson made use of the superorganism as a metaphor to describe ant colonies in his recent book *The Superorganism*, returning the metaphor to its secondary entomological origins.[138] A significant effect of, or perhaps an underlying reason for, Wilson's choice of metaphor is to shape his overall argument that it is the group rather than the individual ant that is the unit of natural selection, which is one perspective in a debate that has had wide reaching implications for biology in the 20th century.[139] Another consequence of Wilson's choice of metaphor is that in his last chapter he finally succumbs to the temptation to compare ant societies to human societies, an exercise that seems fraught with ideological perils of all kinds.[140] The application of the superorganism metaphor specifically to insect societies (by earlier entomologists than Wilson) may partly account for

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136 Rogers, p. 113.

137 Lewis Thomas *The Lives of the Cell* (New York: Bantam Books, 1974).

138 E.O. Wilson and B. Holldobler *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies* (New York: W.W. Norton & Co, 2008).

139 The 'level of selection debate' is mentioned in the next chapter as generating one of the key challenges to the ecosystem model. Wilson's model explains the compatibility of gene-level and societal-level selection, avoiding many of the common errors of previous group selectionists.

140 Ants and humans are both figured as once-rare species whose ability to cooperate has led to numeric dominance. Wilson also argues that we, unlike ants, are ruled by intelligence rather than mere instinct - intelligence that has allowed us to control and destroy the global environment.

its continued influence later in the century, rendering it relevant to later studies in cybernetics and complexity, two of the dominant themes of the second half of the 20th century. This compatibility is exemplified in themes such as the idea of distributed intelligence throughout the superorganism, paralleling ideas of the distribution of information throughout a system.

3. Arthur Tansley's ecosystem

In the early 1930s Arthur Tansley was suspicious of Phillips's and Clements's lexicon. Whilst he allowed 'succession' (although he took issue with the idea that it was of necessity progressive) and 'climax', and even 'quasi-organism', he could not condone the idea of a 'biotic community', nor the analogical model of a complex organism. As we would now see it, the idea of a 'quasi-organism' is actually just as dangerous as the complex organism / superorganism, with the added dimension of greater imprecision. In any case Tansley's principal objection was to the complex organism idea. Tansley's reasons for his response to Phillips seem to have been simultaneously political, philosophical, and ideological, as well as 'scientific' – if science could be seen as a separate category here. His rejection of Phillips's work was vehement and in his response he implied that these sorts of ideas went so far as to amount to an 'abuse' of 'vegetational concepts and terms.'

In his own work Tansley seems to have attempted to avoid the express use of overtly biological and sociological metaphors and analogies. Yet, in preparing to renew the theoretical side of ecology, an exercise that ultimately resulted in the foundational article of 1935 published in the journal *Ecology*, 'The Use and Abuse of Vegetational Concepts and Terms', Tansley had returned to his earlier work in psychology, amassed during a stint at the Magdalen philosophy club between 1931 and 1933, and in earlier studies of Sigmund Freud.[141] Anker wryly points out that this turn to psychology to illuminate the natural environment, 'is not too strange, considering the long tendency among ecologists to create terminology based on analogies to human behaviour.'[142] As Tansley saw it, the physical systems of nature could be investigated using psychoanalytic methods and terminology, in what seems to be a surprising anticipation of some literary theory methods later in the century.

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141 Tansley's own influences also included the Danish botanist Eugenius Warming, whose work Phillips had questioned in his paper.

142 Anker, p. 136. Anker suggests that the idealists and realists of the club were in fact Tansley's main audience, and that his writings should be understood as an attempt to answer the critique coming from the vocal idealist group. Anker, p. 138.

Although Tansley's use of the word ecosystem is the first appearing in print, in a discussion with his son in the early 1980s the plant ecologist A.R. Clapham, who had worked at the Department of Botany at Oxford with Tansley in the 1930s, remarked that he had suggested the word to Tansley when Tansley asked him to think of a word that would denote the physical and biological components of an environment in relation to one another. Tansley did not acknowledge this in his 1935 article, but if true it is interesting in that it suggests Tansley was already thinking in these relational terms five years before the publication of 'The Use and Abuse of Vegetational Concepts and Terms.'[143] In describing the ecosystem in that article Tansley explained that:

> 'the more fundamental conception is, as it seems to me, the whole *system* (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome […] Though the organisms may claim our primary interest, when we are trying to think fundamentally we cannot separate them from their special environment, with which they form one physical system.
>
> It is the systems so formed which, from the point of view of the ecologist, are the basic units of nature on the face of the earth. Our natural human prejudices force us to consider the organisms […] as the most important parts of these systems, but certainly the inorganic "factors" are also parts – there could be no systems without them, and there is constant interchange of the most various kinds within each system, not only between the organisms but between the organic and the inorganic. These *ecosystems*, as we may call them, are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom. The whole method of science […] is to isolate systems mentally for the purposes of study, so that the series of *isolates* we make become the actual objects of our study, whether the isolate be a solar system, a planet, a climatic region, a plant or animal community, an individual organism, an organic molecule or an atom. Actually the systems we isolate mentally are not only included as parts of larger ones, but they also overlap, interlock and

[143] A.J. Willis, 'Arthur Roy Clapham, 1904 – 1990' *Biographical Memoirs of Fellows of The Royal Society* 1994 39 pp. 73-90 at p. 81.

> interact with one another. The isolation is partly artificial, but is the only possible way in which we can proceed.'[144]

Tansley's first use of the term raises a number of ideas. Firstly, there is the express understanding that an ecosystem combines both living and non-living factors, and that 'interchange' takes place between them. In acknowledging the significance of non-living, or abiotic factors, Tansley also acknowledged the innately anthropocentric and biocentric tendencies of ecologists, which of necessity affect their study of the natural world (a problem that is not confined to ecology, of course). This led – and still leads – ecological scientists to privilege the study of living over non-living matter, despite the critical importance of the non-living elements of the environment in enabling life. The tendency is further exemplified in the ongoing propensity to privilege the study of mammalian and/or 'charismatic' species above others.[145]

We can perhaps identify parallels in Tansley's initial but subsequently buried acknowledgement of the significance of non-living things with Marcella Durand's recent challenge to the continuing anthropocentrism and biocentrism of science and popular culture. Durand calls for an experimental ecopoetry that offers a close concentration upon *things*, and things not limited to those traditionally categorised as 'natural', including 'all beings, objects, systems, and locales – water reservoirs, the inside of televisions, invasive purple loosestrife, "africanized" bee populations, subway tunnels', in an equality of value between 'all living and unloving things.'[146] This is achieved by means of 'things of all possible relations hashing against one another', as Juliana Spahr might put it.[147] Durand explains that

> 'association, juxtaposition, metaphor are how the poet can go further than the scientist in addressing systems. The poet can legitimately juxtapose kelp beds with junkyards.'[148]

In effect, Durand is calling for a better contemporary understanding of ecosystems, achieved by way of the poems that depict them, as systems operating through the interaction of parts of all different types, in a way that returns us to that important but sometimes forgotten

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144 Tansley, p. 299.

145 Charismatic species are those with widespread appeal to humans (such as pandas), often used in propagating environmentalist messages, and more often studied than their less charismatic counterparts. By contrast, most insects, for example, are not considered charismatic, yet are of critical importance in the biosphere.

146 Durand, *Ecology of Poetry*, p.59.

147 Juliana Spahr 'Things of Each Possible Relation Hashing Against One Another' in *Well then there now* (New Hampshire, USA: Black Sparrow Books, 2011), pp. 52-71.

148 Durand, *Ecology of Poetry*, p. 62.

aspect of Tansley's foundational thinking, the abiotic world. Whilst we could read Durand's primary purpose here as seeking to collapse the distinction between that which is 'natural' and that which is 'artificial' or 'cultural', which is a classic (although largely perceived) issue of eco-criticism, there is no doubt that she is also drawing her examples quite deliberately from the categories of living and nonliving. I hesitate to reinforce yet another binary within literary studies, but it does seem to be one that we can genuinely detect within today's science and today's environmentalism. Durand's return, although probably not deliberate, to Tansley's ideas, is timely.

The second significant aspect of Tansley's definition is that the ecosystem is conceptualised as one level of organisation within a hierarchy ranging from the universe down to the individual atom, and that it operates within the context of all other organisational levels of matter. This both justifies the ecosystem as an object of study in its own right within a universal list, and also implicitly links it with other, more established, sciences. Thirdly, Tansley expressly noted that the idea of the 'ecosystem' was generated to assist in the study of the natural world: it was created for a particular purpose (usefulness), it was an abstraction, and it was constructed, factors that are not usually acknowledged, or even remembered, in current popular uses of the term. Fourthly, the central metaphor of the 'system' and ideas of complexity, which would go on to be developed further in later incarnations of the concept, were already present.[149] In presenting the idea of the system Tansley offered an alternative paradigm to the questionable biological metaphors used by earlier ecologists in their quasi-manifestos, but it came with its own baggage. The mention of ecosystems as systems sets the groundwork for a return to ideas drawn from the machine metaphor for nature, though it predates the wider dissemination of systems theory from the 1940s onwards. In part this exemplifies how reliance on a particular theory or hypothesis might direct subsequent work in the field, in the sense that this emphasis on systems laid the groundwork for the cybernetics model.

4. Holism and reductionism

In addition to its social and political dimensions, the work of Phillips, Tansley and their peers should also be seen within the context of scientific and philosophical debates surrounding holism and reductionism. As we have seen, Phillips was influenced by the holistic philosophy of Smuts, and moreover saw ecology itself as an attitude towards facts

[149] According to Anker, Tansley seems to have relied for his systems reference book on Hyman Levy's 1932 *The Universe of Science*. See Anker, p. 154.

and their meaning, as a type of holistic outlook, or even a spiritual experience, rather than a subdivision of biology.[150] The conceptual heritage of the 'ecosystem' of Tansley's formulation, as well as its precursor in the biotic community, also includes the idea that it exists as a whole system and can be studied as a whole, or holistically. However, Tansley and Phillips clearly had quite different approaches to holism.

In general terms, holism is the idea that a particular phenomenon or system should be viewed in terms of the whole rather than simply of its parts, and also that the whole may be more than the sum of its parts – that is, the whole cannot be understood by looking only at the parts, because the system as a whole involves not only the properties of the parts but also the operation of emergent, or indivisible, properties arising from interactions between the parts at all levels of organisation that would not be apparent from a study of the parts alone.[151] Holism is significant in terms of the systems theory, cybernetics, and complexity theory of the 20th century, and has a long history both as a philosophy and as a scientific approach.

Historically, holistic approaches have not generally been popular with the scientific community, in part because they retain an element of 'mysticism' because they do not provide a comprehensive model of how a system operates, and in part because of their associations with outmoded philosophies such as vitalism, and more recent associations with alternative or 'new age' philosophies, as well as with philosophies of the extreme right and left wings and attempts at social engineering. It is also worth noting that 'holism' has had various versions throughout the years, and has evolved from an utter privileging of the study of the whole over its parts to the more modern idea of an approach that seeks to take account of all levels of organisation. This latter approach might be described as one form of pluralism, in that it privileges data drawn from both part and whole, even when these lead to contradictory or incompatible conclusions.

The principle of holism is often placed in opposition to reductionism, an approach that studies parts of a whole in order to formulate some general laws as to how that whole might operate. This is sometimes called a 'bottom-up' approach. Reductionism as an approach to biological phenomena tends to entail the assumption that biological entities can be understood through studying the chemical properties of their constituent parts, and that in turn these chemical properties are explainable in terms of the physical properties of their

150 Anker, p. 146.

151 For a fuller analysis of holism and reductionism, see for example Scott F Gilbert and Sahotra Sarkar, 'Embracing Complexity: Organicism for the 21st Century', *Developmental Dynamics*, 219 (2000), p1-9.

component particles. An ecosystem studied in a reductionist fashion might be depicted, modelled, measured and/or defined solely in terms of its constituent 'parts.'

Both holistic and reductionist approaches have drawbacks when applied in the study of natural or textual systems. One primary problem with reductionist models is that they fail to account for complexity and emergence; another is that too great a reliance on these models may result in an overly deterministic approach to living systems. A particular problem with holistic approaches is the difficulty of delineating the level and extent of an ecosystem to be studied and/or its constituent parts, in a way that allows for a consistent basis for comparison with other such systems and parts. To be properly understood as a 'whole', something must have genuine properties that are unique to the whole and not simply reducible to the properties of its components, and whether or not this requirement is met by 'ecosystems' goes to the heart of the debate as to how we study them. Overall, these sorts of problems also go to the central conflict in science of the simultaneous need for facts and the drive to discover overarching patterns and rules. Contemporary approaches often do seek something of a synthesis between holism and reductionism, and it is arguable that Tansley's approach is more recognisably 'modern' to our eyes than that of Phillips.[152]

When one considers the reductionism/holism debate as another layer in the genesis of the ecosystem concept, it is clear that it was born from a controversy with wide-ranging ideological, political and philosophical implications. Yet Phillips's presentation of biotic communities as a subject 'around which the cross-currents of controversy have begun to swirl, and around which increasingly tempestuous seas are destined to rage,' appears from our perspective to be hyperbole.[153] The extent to which the central metaphors and models of the ecosystem have been accepted relatively uncritically once the initial debates had died down, in ecology and beyond, is perhaps, surprising, particularly given some of its more questionable elements. That is, of course, until one considers the conceptual and ideological usefulness of these elements. In particular, the notion of a community is still used, sometimes interchangeably with 'ecosystem', which muddies the very waters that Tansley was trying to clear, and we still suffer from an implied ecological narrative that suggests a move from disorder to order.

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152 Golley points out that Tansley's holism was also reminiscent of the ideas of Alfred North Whitehead. See Golley, pp. 29–30.

153 Phillips, John p. 2.

5. Interconnected humans

In summary, it seems, then, that vestigial traces of all these ideas still appear today; even contemporary ecology is not proof against its own history. Generic ideas such as harmony and cooperation with the natural world, as advocated by Phillips (very much for his own purposes, as we have seen) have proved persistent, chiming with older currents of ideas, both within ecology and in other discourses.[154] Not all ecocritical scholars and poets are as progressive as Marcella Durand in their thinking. Timothy Morton and Dana Phillips have (separately) pointed out that although concepts such as equilibrium, hierarchy and balance may now be considered outdated among scientists, they continue to be sought out by some popularisers of environmentalist ethics, as well as by certain types of literary critic.[155]

Even within the criticism of scholars with considerable standing, we occasionally find a dubious heritage being imported into their ideas. For example, in Rasula's introduction to *This Compost*, he rather uncritically cites a 1947 remark by Aldo Leopold that:

> 'ecology is the science of communities, and the ecological conscience is therefore the ethics of community life.'

Again, dangerous metaphors such as 'community' are used in support of an explicitly environmentalist ethics, and passed forward into wider discourse. Moreover, Rasula uses Leopold's quote to support his own designation of 'poetry as ecology in the community of words', a problematic metaphor that is so loaded with attitude and history that it would be difficult to unpack it. Perhaps we should not be surprised that Rasula subsequently extends this argument into the statement that 'I do think of poems as ecosystems, precariously adjusted to the surrounding biomass.'[156]

Recently of course there does appear to be some reaction taking place against certain received ecological ideas, although not all literary scholars and poets have caught on as yet. But scrutiny does appear within the work of ecologists from the late 20th century onwards: in 1987, for example, the ecologist Tom Fenchel characterised ecological analogies using nonequilibrium thermodynamics as 'fundamentally false', going so far as to suggest that they had an appeal for some because they were 'sufficiently obscure and incomprehensible to appear profound', which seems a remarkably insightful statement with regard to how

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154 See Anker, pp. 148 and 151 on Phillips's ideas of harmony.

155 See Phillips, p. viii, and also Chapter 2, especially at pp.42 and 46. See also Morton, *The Ecological Thought*, p.3 – these are in fact qualities of reified 'Nature' in Morton's thinking.

156 Rasula, *This Compost*, p. 7, quoting from Aldo Leopold *The River* (1947), p. 340.

these ideas propagate.[157] The sea change in ecology also extends into the work of some of today's more committed and rigorous ecopoets, such as Durand or Spahr, as well as that of critical and rigorous ecocritics, often as part of the wider challenge that has been laid down to detect and excise anthropocentrism, hierarchy and balance. In a phrase that can be read as a critique of the outdated 'balance of nature' and equilibrium tropes, the American poet and critic Jonathan Skinner reminds us in his poem 'Tope Prisms' that 'no true point of balance is ever found.'[158]

However, one idea in ecocriticism that certainly merits a greater degree of examination than it usually receives, and another significant cultural inheritance from early ecology and before, is the idea of interconnection. Tansley's and Phillips's descriptions include, respectively, notions of interchange and interrelation, such as Tansley's foregrounding of the 'interchange' between living and nonliving components of the system. Phillips's work also foregrounds the importance of a particular species in the overall set of connections (or 'web'), although it is important to note that his primary focus in understanding relationships seems at this point to be on demonstrating the connections between animals and plants rather than foregrounding the importance of the part relative to the whole. For example, Phillips begins one section of his article with the exhortation: 'Let us observe the far-reaching influences that the strand of earthworm numbers may have upon the general web of forest life.'[159] The emphasis on connection and relation in the earliest ideas of ecology perhaps partly accounts for the ubiquity of the concept of interconnection in contemporary and popular notions of ecology, as well as its recurrence in ecologically orientated poetry and ecocriticism, a theme to which I will return. For clarity, I am not suggesting that 'interconnection' does not apply to ecosystems, but rather that the term is often used in a vague and generic way that does not add anything useful to any discussion of either ecology or literature. That said, in later chapters I will explore whether ideas of interconnection, connection, and relation, might be of value when invoking complexity theory in respect of language and text.

One way in which the notion of interconnection may usefully be employed within ecocriticism is to remind us of quite how instrumental our own activities are and how much

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157 Tom Fenchel *Ecology: Potentials and Limitations* Book 1 in the Excellence in Ecology series, edited by Otto Kinne (Oldendorf/Luhe, Germany: Ecology Institute, 1987) at p. 17. http://www.int-res.com/book-series/excellence-in-ecology-books/ee1/ [Accessed 12 January 2017].

158 Skinner, Jonathan 'Tope Prisms', in *The Arcadia Project: North American Postmodern Pastoral* eds. Joshua Corey and George Calvin Waldrep (Boise, Idaho: Ahsahta Press, 2012), p.197. 'Tope Prisms' collages material derived from Frank Golley's ecological texts.

159 Phillips, John, p. 11.

our works and processes are not simply imbricated within the works and processes of an external environment, which implicitly entails a dangerous conceptual dualism, but actually constitute it even as it constitutes us. We have always had a mixed attitude towards whether or not we believe our activities truly change the face of the Earth, and to what extent that is within our control, and we can detect these currents even within early ecology. In his conclusion to 'The Biotic Community', Phillips also – strikingly, for 1931 – includes humans within the 'community', noting in a way that, according to our contemporary understanding, is at once quite wrong and quite right, that:

> 'My inclusion of man doubtless will call for much criticism – so to anticipate such I would remind you that despite the ability of man to upset temporarily, to hold in check to some degree, and to accelerate to greater or lesser extent the responses, the reactions, the co-actions and the development of a community, it is more than he can do to alter fundamentally the trend of these. To him certain – and not all – things are possible.'[160]

Tansley's response to Phillips also regarded humans as an exceptionally powerful biotic factor within ecosystems, but in his darker version, which again has more contemporary overtones, humanity is liable to destroy them.[161]

[160] Phillips, John, pp. 19-20.
[161] Tansley, p. 303.

CHAPTER 2

All Watched Over By Machines Of Loving Grace: The Cybernetic Ecosystem

> '*System* has the virtue of seeming less Romantic and misty than *world*. But it merely updates Romanticism for an age of cybernetics. Deep ecology, the most Romantic of all ecological forms of politics, is curiously enough the one most devoted to systems thinking. System can generate its own forms of mysticism.'
>
> Timothy Morton, *Ecology Without Nature*[162]

> 'Systems theory is not easy, and one could die quite happily without having had a taste of it.'
>
> Andrew McMurry, 'Systems Theories and Literary Studies'[163]

> 'If all models are simplifications of nature and therefore never fully capture the range of behaviour of real ecosystems, how "wrong" can a model be and still be useful?'
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> Canham, Cole and Lauenroth, *Models in Ecosystem Science*[164]

1. Information and energy

By the 1950s, an ecological system became a system of energies, as insights from general systems theory and cybernetics were incorporated into the 'ecosystem.' The use of a machine systems metaphor was a logical extension of Tansley's use of the word 'system' which, in the inter-war period, was already beginning to connote emerging systems science. Systems theory studied interrelated phenomena *as* systems, focussing primarily on the patterns and interactions within those systems and de-emphasising the particular nature of the subject matter, whether physics or sociology. It is feasible to think of systems science as a holistic philosophy or a meta-science, as well as a technical study in its own right.

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162 Timothy Morton, *Ecology without Nature: Rethinking Environmental Aesthetics* (Cambridge, MA, USA and London, UK: Harvard University Press, 2007), p. 103.

163 Andy McMurray 'Systems Theory and Literary Studies', in *Traditions of Systems Theory: Major Figures and Contemporary Developments*, edited by Darrell P. Arnold (New York and London: Routledge, 2014), pp. 261-276 at p. 262.

164 Charles Canham, Jonathan Cole, and William Lauenroth *Models in Ecosystem Science* (Princeton and Oxford: Princeton University Press, 2003), p. 9.

In America general systems theory grew from the work from the late 1930s onwards by the German biologist Ludwig von Bertalanffy, and within the broader category of systems theory, work by first and second-order cyberneticians was also of critical importance.[165] Cybernetics was articulated initially by the American mathematician and philosopher Norbert Wiener in his foundational work *Cybernetics, or Control and Communication in the Animal and the Machine*, and by Claude Shannon and Warren Weaver's mathematical theory of information, both of which were highly technical.[166] Wiener's later work including *The Human Use of Human Beings* (as well as the work of second-order cyberneticians) is also particularly relevant from the point of view of ecology, as well as being more accessible to the non-mathematician. We can best characterise the distinction between first and second-order cybernetics using Bruce Clarke's pithy phrase, as the conceptual shift 'from homeostatic regulation to autopoietic recursion', which Clarke argues began at the 1988 Gaia theory symposium that took place in Italy, or alternatively we could conceptualise it as the shift from 'observed systems' to 'observing systems', an idea to which I will return in the chapter on Colin Simms's poetry.[167] The ideas of homeostatic regulation and autopoietic recursion will be unpacked over the course of this and the next chapter. In Europe systems theory had been anticipated between 1912-1917 in the 'tektology' or 'science of structures' of a Russian medical researcher, Alexander Bogdanov, which remains unknown outside Russia.[168] The best known systems-based work was and probably remains the social systems theory of Niklas Luhmann, derived from the American model.[169]

Cybernetics is the science of communications and control systems in both machines and living things, characterised by information networks linking all parts of the system together. A key concept in cybernetics is that of feedback, the modification or control of a process or

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165 At least one scholar disagrees with Bertalanffy's contention that systems theory is the umbrella term and cybernetics a subset. See for example Ranulph Glanville's chapter 'Cybernetics', in Arnold, Darrell P. ed. *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 45-77.

166 Ludwig von Bertalanffy *General Systems Theory* (Harmondsworth: Allen Lane, 1971). Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge: MIT Press, 1948). Claude Elwood Shannon and Warren Weaver 'The Mathematical Theory of Communication' in '*The Mathematical Theory of Communication* ed. Shannon and Weaver (Chicago: University of Illinois Press, 1963), pp. 29-125. Shannon and Weaver's theory was first published in 1948.

167 Bruce Clarke 'Autopoiesis and the Planet' in *Impasses of the Post-Global* edited by Henry Sussman (Ann Arbor, MI: Open Humanities Press, 2012), pp. 58–76 at p. 73. Accessed online at http://quod.lib.umich.edu/o/ohp/10803281.0001.001/1:4/--impasses-of-the-post-global-theory-in-the-era-of-climate?rgn=div1;view=fulltext [8 January 2017].

168 See Capra and Luigi, pp. 84-85. Capra points out that a German language version of Bogdanov's work was published in Germany in 1928, of which Bertalanffy may have been aware, although he did not credit Bogdanov as a source. Bogdanov's work also pre-empts that of Wiener, Prigogine and Rene Thom by many decades.

169 Later, dynamic systems theory was developed by Prigogine and others, with developments into chaos and complexity theory, as discussed in later chapters.

system by its results or effects, for example in a biochemical pathway or behavioural response.[170] That is, feedback loops *are* the control and communication of Wiener's title. Feedback may be described as positive – the enhancing or amplification of an effect by its own influence on the process that gives rise to it, or negative – the diminution or counteraction of an effect by its influence on the process. As Ranulph Glanville conceptualises it, feedback provides a way of dealing with error. The acceptance within cybernetics of the ubiquity of error is distinctive of the subject (negative feedback is error-reducing and positive feedback is error-increasing feedback, in Glanville's taxonomy).[171] An alternative way of conceptualising feedback is as a type of systemic *memory*. Within the idea of feedback, we see the first seeds of the idea of self-organisation.

In morphing into a cybernetic system, the ecosystem was in company with a number of other phenomena. The subtitle of Wiener's foundational book explicitly placed the animal and machine in a common category and glossed over distinctions between them. The use of machine systems to describe living as well as nonliving systems was applied to nearly every discipline following World War II, including biology, psychology, and the social sciences. Diverse subjects such as the human body, the carbon cycle, and weapons systems were all, crucially, understood as self-regulating systems that could be controlled by regulating the flow of information.

In one strand of the ecosystem concept's development, which fed directly into the mainstream teaching of ecology in America, the influential American ecologists Howard and Eugene Odum applied the idea of the cybernetic system to the ecosystem, with energy flows taking the place of information. Conceptually, the idea of energy flow as the defining factor within an ecosystem had been enabled by work that imported notions from thermodynamics into ecology, such as that by the British ecologist Charles Elton and his food pyramid, based on the notion of nature as a competitive economy, and Lindeman's highly regarded 1941 study of trophic dynamics, which studied ecosystems according to the movement of energy within them and also fitted with contemporaneous analyses of economics as well as the systems theory ideas that influenced both discourses.[172] A further

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170 This definition of feedback is taken from http://www.oxforddictionaries.com/definition/english/feedback, accessed 14 July 2014.

171 Ranulph Glanville 'Cybernetics', in Arnold, Darrell P. ed. *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 45-77, at pp. 52-53.

172 Other influential ecology textbooks around midcentury were *Principles of Animal Ecology*, by Allee, Emerson, Park, Park and Schmidt (1949), and *Natural Communities* by Dice (1952). Elton's and Lindeman's ideas were brought into ecological literature in such texts, for example, as Aldo Leopold's 1949 *A Sand County Alamanac* and its profound respect for ecological interconnectedness described as

necessary link had been made in a paper by Evelyn Hutchinson in 1948, 'Circular Causal Systems in Ecology'.[173]

Eugene Odum similarly made use of ideas derived from systems theory as well as from economics as organising principles in his influential textbook *Fundamentals of Ecology* (originally published in 1953), which represented the ecosystem schematically.[174] One of the key messages of the text was that the law of organic nature is to bring order and harmony out of the chaotic materials of existence. Odum seemed similarly determined to bring order from the chaos of ecological science, by formulating key ecological principles and structuring the chapters of *Fundamentals of Ecology* around them. This tactic rendered his book very accessible and perhaps partly accounted for its significant influence. *Fundamentals of Ecology* viewed nature as a series of balanced ecosystems, necessitating a unified theory of the ecosystem as:

> 'any entity or natural unit that includes living and nonliving parts interacting to produce a *stable* system in which the *exchange of materials* between the living and nonliving parts follows *circular paths* is an ecological system or ecosystem. The ecosystem is the largest functional unit in ecology, since it includes both organisms (biotic communities) and abiotic environment, each influencing the properties of the other and both necessary for maintenance of life as we have it on the earth. A lake is an example of an ecosystem' [my emphasis].[175]

Within this fictional ecosystem, the flow of energy was used to define its trophic structure, biotic diversity, and material cycles. The interaction of system parts produced a stable system.

The systems based model of the ecosystem was not without its detractors, and some debates took place between the proponents of the cybernetic model and the more conventional Darwinian biologists with whom Odum did not see eye to eye. In particular, the cybernetics approach seems to have had less traction in Britain, compared with America, although it is

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'thinking like a mountain.' Describing a dying wolf, Leopold effectively describes a trophic cascade, which occurs when predators in a food web suppress the abundance or alter the behavior of prey (releasing the next trophic level from predation). Aldo Leopold *A Sand County Almanac and Sketches Here and There* (New York: Oxford University Press, 1987).

173 Evelyn Hutchinson, 'Circular Causal Systems in Ecology' *Annals of the New York Academy of Sciences* 50, 1948: pp. 221–46.

174 Eugene P. and Barrett Odum, Gary W., *Fundamentals of Ecology*, (Australia, Canada, Mexico, Singapore, Spain, UK, US: Thompson Brooks/ Cole, 2005).

175 This citation is from p. 9 of the 1953 first edition of *Fundamentals of Ecology*.

also true to say that the wider concept of ecosystem studies, whether based on a systems theory model or not, was generally less popular in Europe than it was in America. Golley suggests that among European scientists the ecosystem idea was unpopular because, after World War II, the holistic bent of ecosystem studies seemed too close to fascist philosophies of ecological and social organisation to be popular.[176] By contrast, in America the 'ecosystem' idea lacked this ideological heritage, and appeared modern and up to date, especially because of its growing association with exciting developments in cybernetics and machine systems.

One challenge to Odum's model was offered in the 1970s by the British plant ecologist John Harper, who on reading a recently published book by Wynne-Edwards (an ecologist interested in colonial birds) was moved to ask the question of the level at which selection occurred, whether that of the group or that of the individual organism. If, he argued, nothing in biology has meaning except in the light of evolution and if evolution is about individuals, their descendants, and their fitness to a particular environment, there could be no depth of understanding achieved by studies based at the level of the 'super individual', or ecosystem, whether it be the flora and fauna of the descriptive ecologist, the efficiency and resource cycling studied by the production ecologist, or the gross population phenomena of the population ecologist.[177] Harper concluded that what we see as the organised behaviour of systems is the result of the fate of individuals.[178] This of course chimes with heated biological debates that took place throughout the latter part of the 20th century as to the level at which selection occurs, from the infamous "selfish gene" of Richard Dawkins, up to entire populations. Group selection holds that Darwinian selection occurs on multiple levels, including the gene, the individual, and in species with a high level of sociality, on the level of the group itself. The fierceness of this debate highlights one of the major challenges of ecological thinking in terms of systems: it rests upon assumptions that have not been established.

From the 1970s onwards evolutionary ecology did have an impact on the ecosystem paradigm, and the dominance of Odum's model was to some extent eroded by the existence

176 Golley, pp. 2 and 187.

177 Richard Dawkins *The Selfish Gene* (Oxford: Oxford University Press, 1976).

178 J.L. Harper 'The Contribution of Terrestrial Plant Studies to the Development of the Theory of Ecology', in *Changing Scenes in the Natural Sciences: 1776 – 1976*, ed. C.E. Goulden (Philadelphia: Academy of Natural Sciences, 1977), pp. 139-158 at p. 148. In this thinking, Harper was drawing on a 1973 article by the ecologist Dobzhansky entitled 'Nothing in biology makes sense except in the light of evolution.' Dobzhansky, T. 'Nothing in biology makes sense except in the light of evolution' *American Biology Teacher*, March 1973, pp. 125-29.

of this alternative and approaches based at both individual and population levels. In another significant challenge in 1979, the medical researchers Engelberg and Boyarsky classified systems into 'cybernetic', and 'non-cybernetic' – the category which, according to them, included ecosystems.[179] In Engelberg and Boyarsky's view, cybernetic systems had three characteristics that were absent in ecosystems. Firstly, cybernetic systems were characterised by global information networks that integrated the parts of the system. Secondly, this integration took the form of feedback loops that could be described as goal seeking. Thirdly, this feedback always involved low-energy signals that controlled high-energy processes. Engelberg and Boyarsky denied that feedback loops between predator and prey populations could be cybernetic, because they involved brute force energy transfers rather than low-energy signals controlling high-energy processes. They also denied that carbon or nitrogen cycles acted to integrate ecosystems in the same way that, for example, hormones regulate the body. The work of Engelberg and Boyarsky drew retorts from those ecologists who agreed with the homeostatic model, including Odum himself, and attempts were made to explain away Engelberg and Boyarsky's criticisms as late as 1981.[180]

Papers such as that by Harper and by Engelberg and Boyarsky effectively drew attention to some of the limitations of the cybernetics-based ecosystem model to conceptualise ecosystems, the most significant (and, from our perspective, obvious) of which is that comparing energy flows within ecosystems and information flows within cybernetic systems means making a radical reduction of myriad environmental interactions between multifarious ecosystem components to a few energy flows. The most basic problem with it is that it is too simplistic and reductive an idea, and fails to take account of the operation of stochastic factors. Natural systems observed in the real world do not, to the frustration of many, accord with cybernetics based models. The response of some ecologists to these problems, in carrying out controlled-environment experiments, studying microcosms and mesocosms, or – in line with rationalist traditions – computer modelling, create more problems than they solve. Isolating a model ecosystem ignores the operation of the cross-boundary feedback from the environment that is instrumental to these open systems, and is hence an almost completely meaningless exercise in terms of garnering knowledge.

There is something to say here too about Odum's easy replacement of 'information' from the cybernetics model with the concept of energy, and about the equation of the two in the

179 J. Engelberg and L. L. Boyarsky, 'The Noncybernetic Nature of Ecosystems', *The American Naturalist*, (1979) Vol. 114, pp. 317-324.

180 S. J. McNaughton and Michael B. Coughenour, 'The Cybernetic Nature of Ecosystems', *The American Naturalist* (1981) p. 117.

work of systems theorists such as Wiener and Shannon and Weaver: this metaphor is not without some highly questionable dimensions. For example, famously, energy can neither be created nor destroyed; 'information' can be. 'Information' has communication connotations, unlike energy. Moreover, 'energy' has, even to physicists, something of a mystical edge, and we are not quite sure what it is other than that it is a physical property of objects that in a physical sense allows things to happen, can be transmitted, and can be converted (incidentally, it does not 'flow'); by contrast, information is both abstraction and, often, construction. Odum's ecosystem had particular shortcomings as a predictive model partly because of its faulty premises about energy, such as the perceived pre-eminence of energy efficiency in the model. As the ecologist Tom Fenchel puts it:

> 'Odum's attempt to describe ecosystems largely in terms of energy flow is at best a descriptive approach, but strongly deceptive if used as a predictive or analytical tool. The fundamental reason is that neither in an ecological nor in an evolutionary context is efficiency in terms of energy conversion necessarily maximised or in any way the most important factor. The developed models may therefore describe energy flow in a static ecosystem, but cannot predict how that system will change over an ecological or an evolutionary time scale, nor how other, not yet studied ecosystems may function.'[181]

We can speculate that Odum's error in thinking of terms of energy efficiency within an ecosystem comes from his underlying choice of metaphor of the ecosystem as a cybernetic system. A cybernetic system has a goal, and is self-regulating. It uses a feedback mechanism in the pursuit of that goal. That goal might well be the conservation of energy, for example, as it is in living individuals. Bodies, according to Gary Snyder, are 'temporary energy traps in which energy is held briefly and can be deferred into other uses, other ecosystems, on the path of energy from the sun to the energy-sink in the universe.'[182] It is valid to conceptualise a human or nonhuman body in these terms, since the receipt and use of energy for its own self maintenance and ordered organisation is the thing that prevents a body from dissipating into disordered entropy, and hence a desirable outcome. There is no need to import any element of mysticism into the idea of a body having the goal of energy conservation and hence survival if we agree with the basic precepts of Darwinian and post-Darwinian theories of evolution, for those that did wish to conserve energy and live or, for example with single

[181] Fenchel, p. 17.
[182] Lee Bartlett 'Gary Snyder and Lee Bartlett Interview' *California Quarterly* 9 (1975), pp. 43-60 at p. 48.

celled organisms that we do not think are conscious, were simply good at conserving energy and hence at living, survived to reproduce. We cannot apply this thinking to an ecosystem. An ecosystem does not have a goal. It does not have a consciousness with which to pursue a goal (whatever some of the more alarming versions of the Gaia hypothesis might suggest). Nor does an energy efficient ecosystem survive and continue because it is selected for in an evolutionary sense. Ecosystems are not selected for in an evolutionary sense. They do not compete. Energy is not the teleological force that *drives* an ecosystem, however much we can and do correctly detect its movement within that system. In effect, this is to restate John Harper's criticism from a slightly different perspective, but it is the same point.

The point of confusion in the work of Odum and certain other biologists, as well as in the work of those exploring these ideas in other discourses, such as Snyder, arises because in some respects an ecosystem might be seen to *resemble* a living body. The idea of energy conservation is therefore imported from one analogical domain into another. I will return to this point in the discussion in the next chapter on Gaia and autopoiesis, because similarly a self organising bounded system must have a 'goal' for the purposes of organisation. Autopoiesis is in fact an emergent property of a system, at least in the case of an ecosystem as a complex system, rather than a goal or end purpose. Where we think in terms of a smaller system, such as a plant or animal, it is not too great a stretch to couple the idea of autopoiesis with teleology – that is, the final cause of the individual is to organise and maintain itself. When we perceive this within an ecosystem, it is a coincidental resemblance, a facet of emergence. In other words, unfortunately we have never really left the idea of a superorganism behind, although we have made it sound more scientific by couching it in the language of physics and communication science. Perhaps our anthropocentrism does not allow us, conceptually, to leave it behind.

Odum (and Snyder, as we have seen), read in another goal seeking behaviour to ecosystem processes. That is, they theorise about a system's goal of self-regulating homeostasis, a new take on the stability/diversity hypothesis originally suggested by Arthur Tansley as well as the ancient 'balance of nature' idea. Odum did not generally use the earlier terminology of the climax, but offered a very similar idea of an orderly progression towards the 'mature ecosystem', which, in line with its cybernetics derivation, reassuringly fluctuated around a single homeostatic point – a theme that, as we know, is problematic. As Joel Hagen points out in his essay 'Eugene Odum and the Homeostatic Ecosystem' in *Traditions of Systems Theory,* although Odum subsequently claimed that homeostasis had been central to his thinking from the beginning, it does not appear in *Fundamentals of Ecology* until the second

edition, which was published in 1959.[183] The emphasis on equilibrium that results from Odum's use of cybernetics is a natural successor to Tansley's 'balanced equilibrium', and it is also striking that in line with Phillips's work organisms are once again described as 'biotic communities.' It is also not a large conceptual leap from Odum's homeostasis back to the old idea of the 'balance of nature' and the notions of stasis rather than dynamism that that entailed: Odum's ecosystem might fluctuate, but, on a larger time scale, it self-regulated in order to stay still.

Systems theorists and cybernetics proponents are often pragmatic and instrumentalist at heart: ideas and theories are seen as tools, provisional, limited, and subject to the feedback of trial and error. Many systems theorists view practice as serving as the ultimate 'feedback' on the value of a theory.[184] Pragmatism (as an approach to the challenging complexities of the natural world, as well as to our textual artefacts), is discussed in a later chapter, but for the purposes of this chapter it is worth noting that there can be no doubt that Odum similarly brought both a pragmatic and an instrumentalist attitude to bear in creating his model of ecology. His agenda was overtly social and political as well as scientific: Odum situated humans fully in the biological world, accentuating the reciprocal relationships between human and nonhuman aspects of the world, and he was a strong advocate of what we would now call 'sustainability.' It is not too much of a leap to wonder whether Gary Snyder so easily absorbed and reiterated these ideas because of his shared environmentalism, in addition to his Buddhist leanings.

Odum's purpose is hinted at in the subtitle of his later book, *Ecology: A Bridge Between Science and Society*, which was the 1997 title of a revised version of Odum's even more explicitly entitled 1989 text *Ecology and Our Endangered Life-Support Systems.*[185] For example, in *Fundamentals of Ecology*, Odum argued that mature species of lichen were not parasitic but were truly symbiotic with their host, a state of affairs he advocated for people in relation to their environments in order to avoid destroying themselves, an example that

183 Joel Hagen 'Eugene Odum and the Homeostatic Ecosystem' in Darrell P. Arnold 'Systems Theory – A Secret History of the 20th Century' in Darrell P. Arnold *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 179-193 at p. 180.

184 Darrell P. Arnold 'Systems Theory – A Secret History of the 20th Century' in Darrell P. Arnold *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 10–19 at p. 15.

185 Eugene P. Odum *Ecology: A Bridge between Science and Society* (MA, USA: Sinauer Associates, Inc., 1997), updating Eugene P. Odum *Ecology and Our Endangered Life-Support Systems* (MA, USA: Sinauer Associates, Inc., 1989).

seems to invoke the work of Margulis, which will be discussed in the next chapter.[186] More generally, Odum's emphasis on homeostasis, stability, and harmony sat in opposition to the Darwinian emphasis on the survival of the fittest, competition, and predation, an emphasis in the work of contemporary biologists that Odum explicitly criticised.[187]

However, it hardly needs to be said, as I pointed out in the previous chapter, that an ecosystem has no desire or goal (or 'strategy', as Odum rather worryingly calls it in his article) for or of homeostasis. Where homeostasis happens, it happens as an emergent property deriving from other factors. But homeostasis does not always happen. Moreover systems can tip from one homeostatic setup to another, possibly in catastrophic ways such as those we fear may result from climate change. We would now conceptualise ecosystems as 'edge of chaos' systems. These are one of four types of complex system, and are the category that also includes living bodies (and, arguably, poetic/cultural systems), characterised by their existence at the 'edge of chaos.' More will be said about this later.

In addition, although the cybernetic model, used as a comparison for nervous or other biological systems, does itself allow for the existence of emergent properties – that is, properties whose behaviour cannot be reduced or explained by means of the individual laws governing the component parts – and a cybernetic system is indeed somehow 'more than the sum of its parts,' it nevertheless does not help us to model or explain emergent properties in any very precise or useful way. In other words, it represents something of a return to the innately mystical qualities implicit in holistic thinking. The metaphor might begin to describe or express the existence of complexities, contingency, and emergence in the relationships between living organisms, but otherwise it essentially leaves us none the wiser. It is perhaps mainly for this reason that modern versions of the ecosystem have moved forward into complexity theory, one of many intellectual successors to cybernetics, although of course with an acceptance of complex emergence comes further problems with modelling.

2. Louis Zukofsky and the steersman

The cultural and scientific dominance of the cybernetics metaphor in the late 20th century is also evident within some poetry as well as some ecology. One example of this, and of how poetry might interrogate and challenge the models of science, can be found in the long poem 'A' by the American Objectivist poet Louis Zukofsky. The Objectivists were second

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186 This example is given at p. 183 of Hagen's chapter, 'Eugene Odum and the homeostatic ecosystem.' His example is taken from p. 233 of the 3rd edition of *Fundamentals of Ecology*.

187 Hagen, p. 183.

generation modernists who initially emerged in the 1930s, influenced by Ezra Pound and William Carlos Williams, of whom the key figures were Louis Zukovsky, George Oppen, Charles Reznikoff, and later Lorine Neidecker.[188] According to Zukofsky's various statements of their poetics, Objectivists sought to treat the poem as an object, to emphasise sincerity, intelligence, to look clearly at the world and, according to Zukovsky, to 'think with things as they exist' – that is, firstly not to be too figurative or metaphorical but to use language more literally, and secondly to use poetic praxis itself as a way of thinking.[189] One can make far too much of Zukofsky's precepts, particularly given that they were largely inherited from an earlier generation of poets and that they were employed initially at least for the very specific purpose of grouping a disparate group in an editorial article, but the particular notions of thinking with things as they exist and of thinking with poetry are useful for my purposes and do seem to play out in his work.

'A' is in 24 sections which vary widely in style and subject matter, written over the period between 1928 and 1975. Of these 24 sections, the section 'A22' was written between 1970 and 1973 and can be read as a history of the earth and of humanity, encompassing a variety of ideas and discourses such as evolution, ecology, philosophy, geography, religion, and so on. It also explores the history of ideas, as part of which it incorporates traces of various scientific metaphors of the period. It is thus a highly ambitious project. As Jed Rasula puts it, 'to read *A* is to become an adept of the compost library' not only, we infer, because of its engagement with themes of the sleeping and the dead in Gilgamesh's quest for eternal life, but also because of its sheer size, scope, and allusiveness.[190]

For the twenty years immediately preceding the writing of 'A22', cybernetics had been the dominant model in systems sciences, including the study of biological systems such as the nervous system and the ecosystem. It is perhaps not surprising that Zukofsky should have been interested in this exciting strand of contemporary thought: his interests included science along with a broader concern over how and what we know, and in 1965, just prior to

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188 In their most narrow categorisation, the Objectivists might be defined by Zukofsky's statement in the 1931 special issue of *Poetry* and those poets anthologised in Zukovsky's 1932 *An "Objectivists" Anthology*. The group did not develop a coherent manifesto or style nor did they view themselves as particularly connected, but their poetics do tend to be recognisably descended from imagism (an insistence on the direct treatment of the 'thing', in contradistinction to symbolism). A wider definition of the group (which is a somewhat precarious endeavour in view of the Objectivists' disparate approaches and the various iterations of their poetics), might include Basil Bunting and the less well-known Colin Simms in the UK, whose work seems to have some hallmarks shared by earlier Objectivists). Objectivist poetry reappeared in the 1960s and beyond, and was influential on various other schools such as the Language Poets and the Black Mountain poets. Rachel Blau duPlessis has argued that even now there is an Objectivist source in the most recent contemporary American poetry.

189 Zukofsky, *Prepositions*, p. 12.

190 Rasula, *This Compost*, p. 12.

the writing of 'A22', he met with Richard Buckminster Fuller, who worked within the cybernetics tradition.[191] In the passage cited below, Zukofsky has appropriated sections of Norbert Wiener's foundational text and interpolated them with phrases and descriptions drawn from elsewhere (the sources for 'A22' include such disparate materials as Henry James's *A London Life*, Chaucer's *Parlement of Fowles* and Shakespeare's *The Tempest*) into his characteristic five word lines. Zukofsky's collagic approach can be thought of as a type of poetic recycling similar to that which Durand advocates:

> '[…]
> what avails the life to
> leaf to flower to fruit
>
> the season's colours a ripening
> work their detail – the perennial
> invariance won't hollow it, no
> averaging makes their tones – Paradise
> the swept brain blood warmer
>
> leaving it eyes' heat stars'
> dawn mirror to west window
> binds the sun's east – steersman's
> one guess at certainty made
> with an assemblage of naught –
>
> yet in cells not vacuum
> recórds as tho horses rushed
> definite as an aching nerve
> pleads feed and feed back –
> spine follows path once born'[192]

Zukofsky is showcasing the cybernetics model as it was applied to human and animal nervous systems rather than to ecological systems. There are a number of references to nerves in that part of the poem, and some of his material for these lines is imported from the chapter 'Computing machines and the nervous system' of Wiener's book. However, this passage also interrogates the broader cultural prevalence and significance of the model, and how valid it might be as a model for biological systems more generally; systems theory, we

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191 Zukofsky and Buckminster Fuller met at the University of Kentucky, Lexington in 1965. See the 'Chronology' in Brian Sholis and John Jeremiah Sullivan *Kentucky Renaissance: The Lexington Camera Club and Its Community, 1954-1974* (New Haven and London: Yale University Press, 2016). p. 172. Zukofsky also incorporated some of Buckminster Fuller's words into 'A' (for example, 'a blind date with/ principle' in A-21 is taken from a newspaper interview with Buckminster Fuller. Later, 'a sphere / of pyramidal honeycomb' is also taken from an article on Buckminster Fuller's 'geodesic dome.'

192 Louis Zukofsky, *"A"*, (USA: University of California Press, 1978), at p. 509.

should remember, de-emphasises the actual subject matter or type of system to which it is applied in favour of an emphasis on process.

'A22' operates to examine – and perhaps critique – Wiener's ideas and the application of machine theories to nature by breaking apart the constituent parts of the model and exploring the instability of the underlying comparisons. The exploration of how these metaphors can operate within a wider context is achieved through the disjunctive placing of cybernetics 'sound bites' within the poem in juxtaposition with other, apparently unrelated, ideas. Part of the effect of this recontextualisation is to mimic the cross-domain effect of Wiener's work, the level of abstraction of systems theory that allows for the collapsing of some (ostensibly fundamental) categoric distinctions, and, more specifically, the biological application of the machine metaphor, by leaping directly between the categories of the animal and the machine. Zukofsky's poetry seems to model a space in which 'machine' and 'animal' are not oppositional categories after all: there is no longer a machine metaphor for nature nor a natural metaphor for a machine, but a third category entirely, something that seems to anticipate the cultural work of Donna Haraway's cyborg in rejecting rigid boundaries and dualisms, neither human, animal, nor machine alone, neither nature nor culture. As Timothy Morton puts it, revealing his own cybernetics-based thinking:

> 'Life forms consist of all kinds of structures that are not very organic, just as there are strange textual forms that do not fit the Procrustean bed of organicism. Humans keep trying to distinguish rigorously between the living and the machinic. Countless sci-fi and horror narratives explore the anxiety that this distinction is untenable. Darwinism and genomics are very bad news for this anxiety, since they show that not only is the distinction untenable, but life as such is a machinic, algorithmic functioning, and that what we call 'life' and 'consciousness' are emergent effects of more fundamental machine-like processes.'[193]

The most overt references in Zukofsky's 'A22' to cybernetics are the reference to the 'steersman' and the reference to 'feedback.' The steersman lies at the heart of cybernetics because, as Wiener points out in both *Cybernetics* and *The Human Use of Human Beings*, the Greek derivation for 'cybernetics' means steersman or pilot, one who steers a ship:

> 'It is the study of messages, and in particular of the effective messages of control, which constitutes the science of Cybernetics, which I

[193] Timothy Morton 'Ecology as Text', p. 7.

> christened in an earlier book. Its name signifies the art of pilot or steersman. Let it be noted that the word "governor" in a machine is simply the latinized Greek word for steersman.'[194]

The explicit inclusion of 'steersman' or 'governor' in the poem further complicates the vehicle of this metaphor for natural systems to incorporate ideas of both machine *and* body, and imports all sorts of notions of teleology, agency, and subjectivity or consciousness into the comparison.[195] It thus draws our attention to one of the problems with the application of a cybernetic model to nature: the governor is a mechanism that mediates the feedback loop between sender and receiver. An example of a governor in a cybernetic system is a thermostat, which mediates between temperature and heat source. When we apply this idea to, for example, the human body or a (supposedly homeostatic) ecosystem, it engenders all sorts of complications, not least reinforcing the idea of a centralised regulator, command or control within a system. This is perilously close to determinism. There is an anthropocentric sense of directedness, an agent/actor, within the system or perhaps *as* the system. Even if we seek to think of control as an enabling behaviour that allows things to happen (as we are sometimes exhorted to do by systems theorists), as cause, or feedback, or self-correction, it still retains notions of *centralisation* that, according to contemporary views, are not applicable to many natural and animal systems and have now been jettisoned.[196] In their defence of the cybernetic nature of ecosystems in 1981, Odum and Patten explain that there is no 'goal setter' within the system and it is not a superorganism; it should not be read as a teleological cybernetic system but is something that emerges passively. However, they go on to acknowledge that the cybernetic model is sufficiently goal-orientated that further explanation is required, and in something of an admission they add that 'Analogy, and the willingness to accept it, are the keys to identifying the cybernetic nature of the ecosystem.'[197] Analogy, of course, can aid discovery, but as we have seen weak analogies can be dangerous, and the fact that Odum and Patten need to exhort the reader to be willing to accept analogy (as opposed to simply being convinced by the evidence) tells its own story.

Whether or not Odum admitted it, there is a pervasive and lingering notion of centralised command and control that derives from the cybernetics focus of his ecosystem model.

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194 Norbert Wiener *The Human Use of Human Beings: Cybernetics and Society* (London: Eyre and Spottiswoode, 1950), p. 9.

195 Greek derivation: χυβερνήτης.

196 See Glanville, p. 54 on control as an enabling behaviour: '[Control] is a difficult concept for many people because it suggests restriction and imposition. Cybernetic control aims to facilitate'.

197 Eugene Odum and Bernard Patten 'The Cybernetic Nature of Ecosystems' *The American Naturalist* Vol. 118 (6), December 1981, pp. 886-895 at p. 888.

Command and control do not accord with contemporary notions of complex ecosystems, however much we might continue to read centralised command and control into human bodies (brains, for example. Even these notions are now challenged by studies of the distribution of processing power and information throughout the body, the central nervous system and the gut microbiome. In addition, cellular processes, cells, genomes and epigenomes, which are massively distributed throughout the body, all contain 'information', process it, and have 'command' or 'control' functions. But that is another story). In ecology, there is no single operator and (unless some sort of deity is assumed to be present) it is not clear who or what the steersman could be unless it is the 'information' flow itself – in this case, an 'energy' flow.

By drawing attention to the presence of the cybernetic model within the poem *only* through the etymological root of the name, 'steersman', Zukofsky is emphasising the anthropocentric features of the model. He is calling cybernetics by its 'name.' In effect the steersman becomes a literal, embodied object in the poem, a pilot who uses the operation of feedback to adjust the course of the system and to control it, a centralised commander and controller. This is not without its ambiguities: it seems at once to accept a Cartesian separation, but also to critique it. Yet, as Zukofsky points out, the steersman is in cells, not vacuum – that is, in 'cells' plural: could the suggestions in Zukofsky's poem be anticipating the distribution of agency and information in a way that would have been at the very vanguard of science for computing applications and, in terms of literary theory and human biology, anticipating work by Alaimo and others? We can only speculate.

Rasula remarks that 'the dearth of paraphrasable meaning is acutely evident in Zukofsky's "*A*," a work that proceeds almost without "thinking" but which everywhere incarnates a fund of sapience'; Don Byrd, more bluntly, remarks that certain passages of A leave the reader 'with the mental equivalent of the bends', arguing that this partly stems from Zukofsky's denial of language's status as an instrument of communication and suggesting that instead both reader and writer are subjects of the poem's energy, which is performed.[198] It is true that the mind baulks at the task of paraphrase and the creative energy required by a readerly act of performance, but the attempt must at least be made to analyse Zukofsky's appropriation of cybernetics ideas. It is not clear to me why Rasula identifies in 'A' 'sapience' without 'thinking', and nor does he explain this remark: the recontextualisation of found materials, and the 'processing' of materials that Zukofsky conducts, certainly seem to

[198] Rasula, *This Compost*, p. 83. Don Byrd, 'Getting ready to read 'A'', *boundary 2*, Vol 10, No. 2, (Winter 1982), pp. 291-308 at pp. 292 and 293.

indicate a thinking process in the poet, who is thinking 'through' or 'by means of' his poetic medium, and engenders a similar level of thinking in the reader. That it, the textual system of author, text, context, intertext, paratext, reader, and so on, arguably results in systemic 'thinking' and feedback.' Poetry, once again, is a mode of and space for cognition. As Williams Carlos Williams phrased it, the Objectivists agreed in 1931 that 'the poem, like every other form of art, is an object, an object that in itself formally presents its case and its meaning by the very form that it assumes.'[199]

However, leaving aside paraphrase in favour of analysis, we can note to start with that the 'brain blood warmer' and 'leaving it' that begins this section of Zukofsky's poem is a collage of words drawn from a particular page of Wiener's foundational book:

> "[...] The ***blood leaving*** the ***brain*** is a fraction of a degree ***warmer*** than that entering ***it***. No other computing machine approaches the economy of energy of the brain' [my emphasis].[200]

By using only the words 'brain blood warmer' and 'leaving' and 'it' from Wiener's text, and relocating these words in close proximity to the idea of 'paradise', Zukovsky's poem at first glance appears to excise the admiration that Wiener has for the energy efficiency of the brain and secondly imports an altogether more mystical dimension to the process of energy use and minimal associated warming that the brain undergoes. Zukofsky's intention in associating the operation of feedback within neural systems with 'paradise' may have been humorous. We are left with the strong suggestion that the models of science are inadequate to describe the mysteries of biological phenomena and cognition. Alternatively, if we read 'paradise' as 'arcadia' or 'ecotopia' or even, in a large conceptual leap 'ecosystem', paradise *is* the swept brain blood warmer, paradise is the energy efficient system, arcadia *is* energy efficiency. This really does seem to satirise the science, in a strong sense, by equating the mystical and the spiritual with the mundanity of 'efficiency.' Or perhaps it is not satire; perhaps there is a signal truth here. The 'perennial invariance' (of cyclical seasonal changes) doesn't 'hollow' our vision of paradise, so why should energy efficiency?

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199 William Carlos Williams *Autobiography*, p. 264, cited in *The Objectivist Nexus: Essays In Cultural Poetics*, edited by Rachel Blau duPlessis and Peter Quartermain (Alabama, USA: University of Alabama press, 1999), p. 3.

200 Wiener, *Cybernetics*, p. 155. In tracking down the references in Wiener's text I am indebted for part of the detail to the website 'Z-site' <http://www.z-site.net/notes-to-a/A-22.php> (accessed 15 July 2014) which records some of the source references for Zukofsky's appropriation of the cybernetic model. The page references I give are to a different edition of Wiener's book than that used on the website.

The stanza following this appears to suggest that the brain, in operation, has only one point of reference, one star, and this star appears in the opposite direction to the direction in which it actually lies. Is Zukofsky here referring to the circularity and recursiveness at the heart of cybernetic feedback mechanisms? Glanville describes one of the forms of cybernetic recursiveness, reflection (as distinct from what Glanville terms 'reflexion', exemplified in the systems-based economic theory of George Soros) as follows:

> 'Reflection entails deep consideration. There is an element, too, of throwing back (in the mirror). [...] Reflection involves a change in the actor-agent.'[201]

Reflection in these terms is a mechanism Glanville associates with the philosophy of Donald Schön and his book *The Reflective Practitioner*. That is, reflection is a way of learning that involves contemplating and evaluating and reflecting this back in a circle in order to create improvement (response to feedback). It is perfectly possible to read this part of 'A22' as suggesting the circularity of the thinking process and the mind altered by feedback.

Wiener makes the point in *Cybernetics* that:

> 'Thus the part of the universe which we see must have its past-future relations, as far as the emission of radiation is concerned, concordant with our own. The very fact that we see a star means that its thermodynamics is like our own.'[202]

This seems to offer our way into reading the phrase 'Eyes' heat stars'': Heat and time belong to stars as much as they do to eyes, it seems; our circumstances are reflected (in opposition) in that of the stars.' Here, notions of thermodynamics (energy) and information (sensory data such as light) are conflated in a way that recalls Odum's and Wiener's problematic conflation of energy and information. This mirroring is paralleled in the formal qualities of Zukofsky's choice of words in the lines 'eyes' heat stars'/ dawn mirror to west window /binds the sun's east', through the symmetries and asymmetries of the letters that make up eyes, heat, stars, west, east. The effect of all of this is to draw out the comparison between the human and the stars: we have the same thermodynamic experience; we are made from the same materials, the same elemental particles of letters, phonemes and morphemes. At the same time, we navigate by the stars and they are our point of reference, an external form in accordance with which our feedback-sensitive systems can operate.

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201 Glanville, pp. 66-67.

202 Wiener, *Cybernetics*, p. 45.

Zukofsky's steersman, however, has only one point of reference, one star, rather than a full complement of relations, a universe of stars, from which to take a 'guess.'

The steersman's one guess at certainty comes from nothing. Here, Zukofsky's poem not only foregrounds and questions ideas of teleology and of agency, observation and the observer effect, but also, by using the word 'guess', he is emphasising the uncertainty and contingency implicit in the generic model (and perhaps simultaneously mocking the uncertainties of science). His 'guess at certainty' could also possibly be attacking the principles of biological determinism that might arise from the imposition of a systems theory model, when the suggestion is made that particular outputs from these systems are predictable. The 'assemblage of naught' relates to the idea of probability, deriving from the following passage in Wiener's book:

> 'Probabilities one and zero are notions which include complete ***certainty*** and complete impossibility but include much more as well. If I shoot at a target with a bullet of the dimensions of a point, the chance that I hit any specific point on the target will generally be zero, although it is not impossible that I hit it; and indeed, in each specific case I must actually hit some specific point, which is an event of probability zero. Thus an event of probability one, that of my hitting *some* point, may be ***made up of an assemblage of*** instances of probability ***zero***' [my emphasis apart from the word 'some'].[203]

In this passage, Norbert Wiener is explaining the paradoxical prospect that many instances of zero can make up a sum of one, which seems to the layman to go against all precepts of arithmetic. This doubtful response to 'feedback' is characterised through the polysemic possibilities of the word 'récord' that precedes it, hinting as it does at repetition and recitation, recording, recursiveness, and memory.[204] The acute accent on the 'e' seems to be suggesting a stress is to be placed on the first syllable, 're', lending it additional weight: the prefix that we use for many processes and actions that are repeated is emphasised. It is perhaps not stretching the interpretation too much to suggest that Zukofsky is presenting feedback as a type of systemic 'memory', not unlike Wiener's characterisation of genetic materials within bodies. But memory, it seems, is faulty and selective in the cybernetic steersman.

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203 Wiener, *Cybernetics*, p. 58.

204 'Record': Chambers *Dictionary of Etymology*, ed. Robert K. Barnhart (New York: H.W. Wilson Company, 2006).

The ‘A22’ excerpt ends with the acknowledgement that ‘spine follows path once born.’ Here we apparently find reference to determinism and linearity and, possibly, again to Wiener’s *Cybernetics*. In the introduction in his discussion of the operation of feedback and the proper interaction between proprioception and the corrective action (response to feedback) in picking up a pencil, Wiener gives the example of the syphilitic infection *tabes dorsalis* in which ‘the kinaesthetic sense conveyed by the spinal nerves is more or less destroyed.’[205] Whilst Zukofsky is not obviously referring to severed spinal connections, he does seem to be emphasising the importance of a linear neural pathway in the developed organism. We are as we are made, and our memories and actions are determined by probability and reactions that take place along the linear and preformed spinal cord. We are cybernetic systems, on this reading, with no free will: Zukofsky’s poem gestures towards some of the ways in which the cybernetics metaphor might be inadequate to the discussion of unpredictable natural systems such as ecosystems and bodies. Finally, Zukofsky reminds us, lest we forget, that Wiener’s theory has to be applied to a real, physical world, not within the vacuum of Wiener’s own abstraction (‘Yet in cells not vacuum’). We also infer that the cells themselves are not within a vacuum; they are open and responsive to their environments, responding to feedback, and perhaps not that pre-determined after all.

Our analysis of ‘A22’ can be framed by a return to Zukofsky’s statement of the fundamental principles of an Objectivist poetics:

> ‘An Objective: (Optics) – the lens bringing the rays from an object to a focus. That which is aimed at. (Use extended to poetry) – Desire for what is objectively perfect, inextricably the direction of historic and contemporary particulars.’[206]

Bound up in these principles is Zukofsky’s preoccupation with the nature of knowledge, coupled with a strong regard for formal concerns, and the lingering influence of Pound’s

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205 Wiener, *Cybernetics*, p. 15.

206 There are differences between Zukofsky's various statements of the Objectivist principles, the two primary instances of which occurred in 1931 in Louis Zukofsky, ‘Programme: ‘Objectivists’1931’, *Poetry* (February 1931), p. 268, and again three decades later (for example, in its first incarnation, “that which is aimed at” is specifically indicated to be a military reference, something which had been removed by the later version. It is beyond the scope of this thesis to consider these differences in detail, but for a very interesting appraisal see Andrew Crozier ‘Zukofsky's List’ in *The Objectivist Nexus*, pp. 275-285. The version I have quoted in this thesis is taken from the essay ‘An Objective’ in Louis Zukofsky *Prepositions: The Collected Critical Essays of Louis Zukofsky, Expanded Edition* (Berkeley, Los Angeles and London: University of California Press, 1981), p. 12.

Imagist imperative of the direct treatment of the thing, whether subject or object.[207] Part of the real difficulty in any attempt to analyse Zukofsky's work is because his Objectivist poetics leads him to present images and objects in a way that runs counter to the reductionist tendencies of some scientific thinking and instead arguably invokes a complex whole with a set of emergent properties.[208] The interacting poetic system that is 'performing' the reading of 'A22' is at once the lens, it is the thing itself, the object on which that lens is focussed, and it is also the historical and contemporary particulars that populate it (such as Wiener's language of cybernetics). Reading the poem turns out to be more than the sum of its parts, no matter how we break it down.

3. The textual system and transmission theories of communication

The title of Wiener's book reminds us that for there to be control there must also be communication; in early cybernetics, the means of communication were taken to be a channel through which messages were transmitted. There is an obvious question mark here as to whether we can use this in an analysis of texts, this time not in the sense of how texts might thematically and formally investigate the themes of cybernetics and systems theory as they were applied to biological systems, but in terms of applying cybernetics as theory. As we have seen, cybernetics is a metadiscipline and an approach, as well as being a subject matter in its own right. In later chapters of this thesis I will consider whether some of the more recent insights of complexity theory, when brought to bear upon textual analysis, might reveal anything about poetry. However, first-order systems theory and cybernetics, whilst the progenitors of complexity theory, offer a distinct model of their own that may or may not also be useful in this regard. This endeavour should be approached in a cautious spirit, however. Shannon himself warned against the too easy appropriation of information theories from one domain to another:

> 'while many of the concepts of information theory will prove useful in these other fields, […] the establishing of such applications is not a

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207 On Zukofsky's attitude to knowledge, see, for example, Mark Scroggins *Louis Zukofsky and the Poetry of Knowledge* (Tuscaloosa and London: University of Alabama Press, 1998), and in particular chapter 2.

208 Zukofsky's own statements of his poetics in fact add a further layer of complication. Mark Scroggins characterises Zukofsky as attempting to systematise his aesthetics and epistemology, and in this attempt Scroggins locates some of the difficulties that we encounter when we attempt to read Zukofsky's work. As Scroggins sees it Zukofsky inherits his poetics of direct perception from Pound and Williams and his critical machinery of 'sincerity' and 'objectification' is in fact an *a posteriori* attempt to systematise the practice of his predecessors within a coherent philosophical framework. See Scroggins, pp. 66-67.

> trivial matter of translating words to a new domain, but rather the slow tedious process of hypothesis and experimental verification.'[209]

Philipp Schweighauser's chapter 'The Persistence of Information Theory' in *Traditions of Systems Theory* considers why Shannon and Weaver's theory of communication has been of interest to a small number of linguists and literary theorists in considering primary texts, given its obvious limitations in this regard (which are basically that it is concerned not with semantics but with minimising interference from an engineering perspective, and it is based on an encoding-to-decoding model between sender and receiver that allows no role for interpretation).[210] Schweighauser explains that our contemporary understanding of information theory comes more from Weaver's 1949 popularisation of Shannon's information theory than from the (technical) original. This is important, because it is questionable whether, without Weaver's modifications, Shannon's transmission model of machine communication is adequate *at all* to describe processes of information exchange within biological or social systems, including texts.[211]

Shannon's definition of 'information' corresponded with Boltzmann's definition of 'entropy', the measure of disorder in a closed thermodynamic system, where thermal energy has dissipated into homogeneity and no patterns exist. This idea is popularly known in its most apocalyptic formulation as the eventual heat death of the universe. Shannon used the same principle to centre his discussion of information and its transmission. In Shannon's view chaotic and entropic messages have greater information value than ordered messages, because as he saw it the amount of information in the message correlates with the number of possibilities from which it has been selected. That is, the greater the number of possibilities from which a message could have been chosen by the sender and the more equal the likelihood that any particular message be selected (in other words, the higher the level of entropy in his metaphor), the more unpredictable by the receiver any particular message will be. For Shannon, a fully unpredictable message would be maximally informative but also unintelligible and, for all intents and purposes, useless, being composed entirely of what we

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209 Claude Shannon, 'The Bandwagon' *Institute of Radio Engineers Transactions on Information Theory* 2 (1956), p. 3.

210 Philipp Schweighauser 'The Persistence of Information Theory' in Darrell P. Arnold *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 21-44.

211 For this reason, many subsequent developments in cybernetics have abandoned many of Shannon's original premises.

know as 'noise.'[212] Shannon did not place any importance upon the receiver's interpretative role, and was also not interested in the meaning behind communication, but only in the efficiency of transmission. In effect Shannon's theory ignores any context surrounding the sending or the receipt of the message. Weaver's subsequent work did move away from Shannon's work to cautiously accept the notion that the sender was not the sole source of authority and meaning, at around the same time as the publication of the theory of the intentional fallacy that later in the century formed one of the central tenets of literary studies.

The ramifications of applying Shannon and Weaver's work to reading the multiple connectivity and intertextuality (the complex relations between texts and their basis in shared codes) of experimental or innovative poetry are extensive. On Shannon's formulation, these poems are high in entropy and contain enormous amounts of noise/information, because of the potential for words to resolve or be interpreted into larger syntactical units in multiple ways and according to shifting contexts. Of course, the recognisable order within these texts means that they are not *maximally* entropic – they contain both message *and* noise. However, from Shannon's particular perspective, because he was not interested in the role of the receiver, the greater the noise and information in the poem, the greater the level of uncertainty over the message, the less 'useful' and the more inefficient such a poem would be. In Shannon's formulation, information is a purely quantitative rather than a semantic measure. It would be difficult to perform a reading of poetry that does not to some extent take into account the question of meaning, although those theorists who like to challenge the traditional focus on interpretation and meaning and seek out the non-representational see some benefit in so doing, and possibly use Shannon's theory for these purposes because of its total lack of regard for semantic considerations. Weaver's essay opens up new ways of thinking about communication and noise, because it reintroduces the semantic considerations that Shannon excludes, but because it does this from the same basic viewpoint as Shannon's – that ambiguity/ noise, including semantic ambiguity, is undesirable, whether it occurs at the sender or the receiver's end – it is still not particularly helpful for reading the dynamics of experimental texts other than to conclude that they are not efficient.[213]

Some thinkers, such as the philosopher Michel Serres, in applying quasi-Shannonian themes of noise, have seen noise and disorder as generative forces, and this is one important way of

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[212] The greater the redundancy in any message (the less the information it contains), the less the vulnerability it has to noise. Given Shannon's underlying agenda - the accurate transmission of information - this makes redundancy necessary in order to combat noise, e.g. distortion.

[213] Schweighauser, p. 22.

considering the concept that is in line with experimental art forms. Additionally, William Paulson has theorised about the functions of noise in eighteenth and nineteenth century French literature in his book *The Noise of Culture* and in a chapter in the collection edited by N. Katherine Hayles, *Chaos and Order: Complex Dynamics in Literature and Science*.[214] In this chapter, entitled 'Literature, Complexity, Interdisciplinarity', Paulson's overall argument is that literature is in effect the noise of culture: literature is not at the centre of culture but it is an information rich margin where messages are distorted. He characterises the 'literary' qualities of texts, their linguistic alterity, as noise. His thinking marries insights on noise that are drawn from cybernetics and information theory with ideas drawn from the subsequent work of Maturana and Varela on autopoiesis, which will be discussed in the next chapter, to conclude that the cultural perturbation caused by literature triggers processes of overall systemic self-reorganisation (autopoiesis) in society. This makes a really extensive claim for the function of literature.

There is also some recent literary critical work by Sam Solnick, Joshua Schuster and, less recently, by Marjorie Perloff, on the idea of noise. The first two of these are of particular interest for this thesis in that they are written from an ecocritical perspective, both concern themselves with systems theory, and Schuster's work does to some extent perform a 'complexity' reading of texts. Sam Solnick's discussion in *Poetry and the Anthropocene* (2017) of the difficult British modernist Jeremy Prynne argues that Shannon's paper constituted his basic model of the transmission theory of communication. Prynne, an avant-garde British poet and one of the founding members of the Cambridge group of the British Poetry Revival, is both formally experimental and preoccupied with questions of science; his work has been described as an information-rich version of Olson's projective verse,[215] and the influence of Olson (as well as of Pound and more generally of Modernism) is clearly visible within his work.

Solnick notes that Prynne's friend the biologist Francis Crick, who was instrumental to determining the structure of DNA and also the source of Prynne's 'reverse transcription' metaphor, was interested in Shannon's transmission model, and argues that Shannon's

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214 William Paulson 'Literature, Complexity, Interdisciplinarity' in N. Katherine Hayles *Chaos and Order: Complex Dynamics in Literature and Science* (Chicago, USA: University of Chicago Press, 1991), pp. 37-53.

215 Rothenburg, Jerome, and Joris, Pierre, eds. *Poems for the Millenium*: *The University of California Book of Modern and Postmodern Poetry,* Vol.2 (Berkeley, Los Angeles, London: University of California Press, 1998), p.587.

lexicon shapes Prynne's description of Saussure's linguistics in *Stars, Tigers and the Shape of Words*.[216]

Solnick suggests that:

> 'Questions of noise and interference are particularly pertinent to Prynne with his interest in philology – not least the way words accrue significance – but also because of his claim in *Stars, Tigers and the Shape of Words* that there might be a reverse transcription which violates the unidirectional data flow, where sound is coded back onto the level of sense.'[217]

To unpack this a little, we need to turn to Prynne's text. In *Stars, Tigers and the Shape of Words* Prynne explores the contention of Ferdinand de Saussure and others that language is a system of differences without positive terms, and consequently the relation between the individual physical signifier and what it denotes is, with minor exceptions, essentially arbitrary.[218] This is placed in opposition to the idea that the signifier is not arbitrary but motivated, and the sound or visual symbol can 'echo' the sense, whether through art and artifice, as Pope put it in *Sound and Sense*, or because words do somehow carry these extra dimensions. Prynne offers two alternatives: if language is an evolved system of meanings and meaning-relations then it would not be necessary for individual ideas to be matched to word forms and the sign could be arbitrary. Conversely, if language is a social code of interactions then anything that can count towards meaning may do so: intonation, style-level, choice of words and of their sounds and echoes.[219] Prynne suggests that although the sign-system might operate according to principles of arbitrariness, literary motivation can also occur *retrospectively*, through socially and historically determined innovative reading, which 'can be intelligibly active as a practice of inscribing new sets of sense-bearing differences upon the schedule of old ones.'[220]

As Solnick explains it, with the occurrence of this *retrospective* motivation 'noise' can *become* part of the message:

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216 Reverse transcription is the now discredited idea that the transcription of DNA to RNA to amino acids is unidirectional.

217 Solnick, p. 163.

218 Jeremy Prynne *Stars, Tigers and the Shape of Words*, William Matthews Lectures 1992, Birkbeck College London. Accessed online at <http://english.duke.edu/uploads/assets/Prynne_StarsTigersShapes.pdf> [23 December 2011]. As many critics have pointed out, this suggests that language constructs rather than reflects reality.

219 Prynne, *Stars, Tigers*, p.1.

220 Prynne, *Stars, Tigers*, pp.14 and 34.

> '[Prynne] terms a motivated sign "reverse transcription", because the transcription of RNA back into DNA is describable as noise in the communication channel that becomes part of the message. Prynne's linguistic analogue sees the noise produced in the communication channel becoming part of a secondary motivation, where the reader finds a connection at the level of sound that gets coded back on the level of idea.'[221]

Solnick uses this theory to elucidate his idea that Prynne's own poetry relies more on interference than it does on communication, and argues that in his poetry and poetics Prynne was posing a challenge to the model of unidirectional flow posed by Shannon's information theory.

There is something of an aporia here between *Stars, Tigers*, Prynne's poetry and Shannon's theory. Solnick's conclusion is not entirely consistent with Shannon's theory, because noise, as Shannon saw it, might be maximally informative but it is effectively useless, which is not the conclusion that Prynne draws about his reverse transcription given that he is effectively arguing that it adds further semantic dimensions to language and is not just useless noise/ information. Moreover Solnick's metaphor of the backwards coding of sound to sense imports a third dimension that was not present in Shannon's original, because Shannon was not interested in the semantic dimensions of the message; the suggestion that sound gets coded back on sense represents a significant leap in application from the purpose of Shannon's paper. Solnick does acknowledge a further discrepancy, in that while in Shannon's original articulation of the idea what happens at the receipt of the message is not a relevant consideration, Prynne is 'not particularly hung-up on authorial intention', and was 'aware of the warping influence of models primarily interested in the one-way information transfer.'[222] This is probably why Solnick uses Weaver's modified paper rather than Shannon and Weaver's original. Despite these minor points, however, Solnick is able to use the transmission theory of communication to develop a rich discussion of Prynne's poetry and poetics and his systemic understanding of language.

The ecocritic Joshua Schuster also brings Shannon's paper to bear as criticism, this time on John Cage's 4'33, remarking that what is striking about Cage is that he:

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221 Solnick, p. 164.
222 Solnick, pp. 165 and 167.

> ‘sides with noise in a culture so desirous for squeaky-clean communication. Cage embraces nonintention against the discourse of command, and refuses to distinguish between chaos and stable ecosystems.’[223]

Entropy, as Schuster would have it, is a principle of irony that operates both to undermine and reinforce the system. In Cage’s work Schuster detects a critique of technology parallel to Heidegger’s concern that humans dominate the Earth, but technology dominates humans: this enframing is the supreme danger of modern life. Schuster’s discussion of Cage through the idea of cybernetics is very suggestive but unfortunately also very brief, as is his coupling of these disparate thinkers. As elsewhere in his book, he glances at exciting possibilities but too swiftly moves on.

Shannon’s transmission theory of communication does not have much in the way of application to ecosystem theory, being far too reductive. There is a clear parallel here with its application to texts. Indeed any attempt to apply it to texts swiftly brings to light the fact that, although the notion of ‘noise’ is suggestive and interesting from a theoretical point of view, ultimately it does not render any reading of the text that we could not have achieved by other means. It is also not particularly helpful to apply the idea of ‘noise’ to an ecosystem, and does not seem to tell us anything about the environment. The reason for this comes back to the energy/information metaphor that underpins the cybernetic ecosystem, with some unfortunate results as we have seen. What would ‘noise’ be in an ecosystem, on Shannon’s model? Simply the dissipation and disorder of discharged energy? This brings us back to our starting assumption that energy efficiency is the guiding precept or goal of an ecosystem, which cannot be correct. That means that we cannot place value or lack of value upon any particular use or any particular discharge of energy. Moreover, to do so risks errors of the type that have been problematic in the history of 20th century science, for example the (erroneous) idea in genomics that certain DNA is ‘intron’ or junk. What this in fact told us was that we did not understand the function of all of DNA, just as we do not understand the function of all of the interactions in an ecosystem. In fact even to use the word ‘function’ in this context implies a dangerous purposiveness.

Later thinkers than Shannon, and those with a different perspective from a communications engineer, are more useful for reading ecosystem dynamics. As Schuster points out,

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[223] Joshua Schuster *The Ecology of Modernism: American Environments and Avant-Garde Poetics* (USA: University of Alabama Press, 2015), p. 114.

> ‘It is only with second-order cybernetic theories that begin to take hold in the 1960s where noise and information begin to be seen as fundamentally intertwined. The idea of viewing entropy as something that complicates ecosystems rather than simply destroying them took on further importance in the work of Gregory Bateson and Lynn Margulis. Bateson, in *Steps to an Ecology of Mind* combined an Odum-style analysis of energy cycles with this wider view of information and noise as co-constitutive.’[224]

Of course, that does not necessarily get us past the problem of the primacy of the energy/information metaphor and the misleading dynamics that it entails.

Interestingly, what a mapping based upon Shannon and Weaver’s transmission theory of communication does reveal to us is the moment of cultural genesis across more than one discourse by which it became apparent that the reception of a message, communication, or text would be a necessary limb of any interpretation. With this, we see the seeds being sown for second-order cybernetics and complexity theory, which intuitively seem more useful for the interpretation of textual and biological systems.

Norbert Wiener put forth a similar idea about information to Shannon’s, but, unlike Shannon’s formulation, in his view the amount of information in a message is in inverse correlation to the amount of entropy. Wiener thus equates *order* (the negative of its entropy, as he phrases it) with information, although, like Shannon, Wiener equated a lower probability of any particular message with a greater transmission of information. As Schweighauser points out, another significant difference in Wiener’s theory, compared with Shannon and Weaver’s, was the fact that it was not a linear and unidirectional model but instead foregrounded processes of exchange and feedback occurring on distinct levels.

In the 1954 edition of *The Human Use of Human Beings* Wiener explained as follows:

> ‘Messages are themselves a form of pattern and organization. Indeed, it is possible to treat sets of messages as having an entropy like sets of states of the external world. Just as entropy is a measure of disorganization, the information carried by a set of messages is a measure of organization. In fact, it is possible to interpret the information carried by a message as essentially the negative of its entropy, and the negative logarithm of its probability. That is, the more

[224] Schuster, p. 114.

> probable the message, the less information it gives. Clichés, for example, are less illuminating than great poems.'[225]

In the equation of literature and its high information value with negative entropy – that is, with order – Wiener anticipates Olson's idea of the transmission of energy by way of poetry, and we can almost square his theory with Gander and Kinsella's characterisation of poetry as a 'curiously renewable form of energy', given that Gander and Kinsella use the word 'form' rather than the word 'source.' When we think of Wiener's theory in terms of exchange and feedback, it is apparent that it creates a role for the reader/the receiver of the message and allows for contextualisation and circularity as well; it is also more obviously useful in terms of the overall parallel review of texts and ecologies that this thesis seeks to perform. Unlike a simple machine with a single input and output and a linear process between, the cybernetics model glances towards the circular, self-organising, self sustaining properties of the complex system, the ecosystem and the text. As Don Byrd might put it, this is neither vicious circularity nor infinite regress, but a third way.[226]

If we read the author/ poem/ reader grouping as a system, in line with Weiner's circular transmission model analysis, we can figure circular feedback as the role of the reader or the broader cultural responsiveness to textual innovation, operating by way of feedback. As a very simple example, by using only the word 'steersman' and not the word 'cybernetic' in 'A22', Zukovsky is setting a puzzle for his audience: possibly an informed reader who was interested in science would have recognised his allusion, particularly in view of the cultural prevalence of systems and cybernetics ideas in the middle of the century, but many more readers might not recognise it. We can speculate that the operation of feedback occurring in the poetic system (author, text, context, paratext, intertext, reader, context) itself would be quite different depending upon whether or not a reader understood the reference.

Most contemporary thinkers would find more to recognise in transmission theories of communication in line with Wiener's circular model rather than Shannon's linear one, and more to recognise in Weaver's opening of the door to the interpretive capacity of the receiver. It seems that T.S. Eliot, at least during the early part of his career, would have agreed with Shannon's theory: in 1919 he remarked severely that 'there is no such thing as

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225 Norbert Wiener *The Human Use of Human Beings: Cybernetics and Society* (London: Eyre and Spottiswoode, 1954), p. 21.

226 Don Byrd *The Poetics of the Common Knowledge* (New York, USA: SUNY Press, 1994), p. 281.

the interpretation of poetry; poetry can only be transmitted.'[227] His poetics can be read as being more in line with Wiener's model. Eliot was a friend and correspondent of Norbert Wiener from the second decade of the 20th century, and both had earlier attended the same Harvard graduate course on scientific method, although a year apart.[228] The critic Robert Crawford characterises *The Waste Land* as cybernetic, in the sense that it is concerned with the transmission of cultural knowledge, perhaps because of Eliot's early friendship with Wiener, his ongoing preoccupation with the nature and transmission of knowledge, and his celebration of the philosopher and mathematician Leibniz that accorded with Norbert Wiener's.[229] As Crawford puts it,

> 'Cybernetics emphasizes the transmission of information as crucial, and as constructing both the communities and the relational patterns on which knowledge depends. So does modernist poetry. Its constant use of textual and cultural allusion sets up a potentially endless knowledge and information flow, and seems designed to do so.'[230]

Crawford distinguishes the modernist approach to knowledge transmission from generic notions of intertextuality by means of its attempts to develop a system of knowledge-government by institutional transmission in academia. Crawford's reading is principally mentioned here because of his idea that the allusions of modernist poetry function in a similar way to hypertext links; he contends that the older metaphor of the palimpsest is too simple to express just how a poem like *The Waste Land* works:

> 'It sets up so many simultaneous relationships, transmits such a multitude of messages, that it offers us a vast database, a growing library of texts, bridges between them, and connections between cultures. Its complexity is a cybernetic one which anticipates the computer age at least as much as it derives from earlier forms.'[231]

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227 T.S. Eliot '"The Duchess of Malfi" at the Lyric: and poetic drama', *Art and Letters* 3 (Winter 1919), p. 39. The quotation is taken from Crawford, p. 188.

228 Eliot's notion of literature seems itself to be systemic in nature. 'Tradition and the Individual Talent' in effect argues that literature is authored by a culture n individual rather than an individual culture, and is relationally structured. T.S. Eliot 'Tradition and the Individual Talent' in John Cook ed., *Poetry in Theory: An Anthology 1900 – 2000* (Massachusetts and Oxford: Blackwell Publishing, 2004), pp. 97–105.

229 Robert Crawford, *The Modern Poet* (UK: Oxford University Press, 2001). See chapter 4: 'Modernist Cybernetics and the Poetry of Knowledge', pp. 170–222.

230 Crawford, p. 189.

231 Crawford, p. 190.

Disappointingly, Crawford does not go on to bring a formal analysis to bear on Eliot's poetry using the lens of cybernetics, and his main argument that derives from cybernetics is simply this point about the transmission of knowledge and the multiple allusiveness of texts. In effect, Crawford seems to be anticipating complexity theory in his focus on this multiple connectedness of texts, but his argument is not made out through close reading or any attempt to demonstrate how this connectedness might have something in common with systems theory. I will seek to extend this type of reading in the discussion of Lyn Hejinian's poetry in a subsequent chapter.

Whilst Crawford's analysis is, broadly speaking, suggestive, he does not unpack the different models of communication in first and second-order systems theory, and as a result his focus seems rather limited to the idea of the cultural transmission of literary ideas rather than on any notions of feedback or recursivity, or any more extensive analysis of how systems theory might actually apply to text. Solnick's analysis, similarly, does not extend to the suggestive ideas of feedback or recursivity, although for different reasons, because of his focus on the idea of noise and on Shannon's transmission model of communication rather than on second-order systems theory or Wiener's later work. Solnick's reading of Prynne is original and inspirational, but uses a slightly odd choice of source material. Solnick is suggesting that Prynne challenges linear transmission models of communication, just as he challenges the unidirectional linearity of the central dogma in biology, but this characterisation of the diachronic dynamics of language seems more suited to Wiener's theory rather than Shannon's linear model. In general terms, later cybernetics does seem more useful for the analysis of texts.

4. Cybernetic recursivity

Another poem that thematically examines cybernetics, this time explicitly in conjunction with the natural world, is Richard Brautigan's 'All Watched Over By Machines Of Loving Grace' (1967), published when Brautigan was poet in residence at the California Institute of Technology:

> I like to think (and
> the sooner the better!)
> of a cybernetic meadow
> where mammals and computers
> live together in mutually
> programming harmony
> like pure water
> touching clear sky.

I like to think
(right now, please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.[232]

In the second of a three-part documentary, entitled 'The Use and Abuse of Vegetational Concepts', the filmmaker Adam Curtis takes Brautigan's poem as manifesto, rather than as ironic statement.[233] This fits Curtis's overall purpose in the documentary, which is to demonstrate that our growing turn to machine-based explanations for natural phenomena and our own cyborg-like behaviour is essentially an exercise in avoiding responsibility. We not only want to be among machines, we want to be machines; we cannot wait for the machine age. This is something that Brautigan's poem seems to articulate.

However, it is difficult to read Brautigan's poem as a 'straight' manifesto, as Curtis seems to. The 'spinning blossoms' of the computers might invoke the 'whirling propeller' of Filippo Marinetti's 1912 'Technical Manifesto of Futurist Literature', as do the liberal sprinkling of exclamation marks in Brautigan's text, but Brautigan's exaltation of machines does not ring true – or, to be more precise, the longing for the machine age rings true, but Brautigan casts doubt upon how this might ultimately turn out for us.[234] Unlike Marinetti, Brautigan has the benefit of hindsight of the first half of the 20th century. The exaggerated cybernetic utopia that Brautigan calls for, his naive tone, and the striking use of parentheses, together lend his poem a sinister quality. In three stanzas Brautigan develops his expanding cybernetic

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232 Richard Brautigan 'All Watched Over By Machines of Loving Grace' https://allpoetry.com/All-Watched-Over-By-Machines-Of-Loving-Grace [accessed 8 December 2016]

233 Adam Curtis, The Use and Abuse of Vegetational Concepts documentary,1998

234 Filippo Marinetti 'Technical Manifesto of Futurist Literature', in John Cook ed., *Poetry in Theory: An Anthology 1900 – 2000* (Massachusetts and Oxford: Blackwell Publishing, 2004), pp. 56–60.

landscape, from a meadow, to an entire forest, and finally to what we might conceptualise as Brautigan's view of the 'climax' of a 'cybernetic ecology', which is at once both landscape and something more than landscape, a type of totalising relationship. Whilst this ecology has all the hallmarks of a self-contained ecosystem, featuring sky, water, animals and plants, at the same time it is not fully recognisable.

Mammals and computers are figured as 'mutually programming' in the first stanza; by the end humans and nonhuman animals have joined together, but exist separately from the machines and under their watch. In what seems to be a direct challenge to the equation of man and machine in systems theory, Brautigan keeps them as very distinct – and hierarchical – categories. The human and nonhuman animals are no longer on a programming par with the machines. They have unfolded from this chiasmic intertwining of subjectivities into a subsidiary role that is quite distinct from that of the machines. The machine is figured in a quasi-parental capacity or one of guardianship; it is capable of emotion and of grace, godlike in its superiority to the organic beings. Formally speaking, the recursive loops performed in the three sections of the poem seem to model a cybernetic feedback system that is running out of control, spiralling around a moving point of reference, which ultimately ends with a strong suggestion of biopolitics as the organic beings are 'watched over', pre-programmed into docile, self regulating bodies. In other words, Brautigan's utopian fantasy turns out not to be homeostatic at all, but progressive, ending in a disturbing (dis)integration and a systematic paradigm that we can envisage as a nonlinear web of circulating gazes. We can read Brautigan's poem as a critique of the dominance of the cybernetic model and, more generally, an unnerving vision of where technology might take us. Yet in its parenthetical imperatives, 'All Watched Over' also satirises humankind's headlong embrace of this destiny.

5. The observer within the system

A final point to note about Brautigan's poem is the fact that he foregrounds the role of observation. If we characterise the difference between first and second-order cybernetics as observed systems, moving to observing systems, we can see that the poem showcases an observed system of human and machine, but that there is also observation occurring within the ecosystem depicted in poem (indeed, it is even a 'loving' observation). This does not go so far as to offer the notion that the wider poetic system including the reader is observing itself and incorporated within the system, but at the same time it does seem to hint at something beyond first-order cybernetics. This is a theme that I will explore in the chapter

on Colin Simms's poetry, with particular reference to the idea that, as Glanville puts it, entities may switch between the roles of the observed and observing. There is a continual circular switching between roles.[235] This recognition of the implication of the observer in the system also corrects many of the more problematic aspects of first-order systems theory. Characteristically, second-order cybernetics is more interested in learning than in knowledge.[236]

In summary, the shortcomings of first-order cybernetics in terms of any application to ecology are apparent. It is still concerned with command and control, as the subtitle of Norbert Wiener's first book and the poetry of Zukofsky, in their very different ways, make clear, and it is still implicitly an anthropocentric model. In terms of ecosystems in particular there is an issue with the equation of energy and information. It is not necessarily such a problematic metaphor when applied back to texts, but at the same time it does not offer any particular insights other than implying an idea of dynamism. To say that texts are about the transmission of information or communication is highly reductive; they are more dialogic and dynamic, although the notion of "noise" within text has been fruitful for some literary theorising. Even then, we must take care: there is no goal seeking behaviour within culture or a poetic system, any more than there is a goal of energy efficiency within an ecosystem. Neither a textual system nor a natural one is homeostatic.

Some contemporaneous poetry did critique this dominant paradigm. It is in one way reasonable to read these poems, if not as models of models, then as homologues – or better yet, isomorphisms – of models of first-order cybernetic systems, and particularly with reference to transmission theories of communication.[237] In fact it is more reasonable to apply these ideas to texts than it is to apply them, as Odum did, to biological systems such as ecosystems, because they are from the very beginning theories of communication. It is important to remember that first-order cybernetics always deals with the idea of models; it is in essence simply a way of reading things anyway.

When we think of applying system theories to texts, more advantages become apparent, and the disadvantages seem less pronounced, if we take as our model second-order cybernetics. Yet already, even within early systems theory and before complexity, the importance of relations, connections, and recursivity begins to become apparent, and even readings based on Shannon and Weaver's work do serve to illuminate something about texts (even if only

235 Glanville 'Cybernetics', p. 69.
236 Glanville 'Cybernetics', p. 60.
237 In biology, isomorphisms have unrelated ancestry but shared characteristics.

the need for a much more complicated way to theorise 'communication' than existed at that stage in science). In Germany there is some interest in systems theory based media criticism, but elsewhere systems theory has not been extensively used by literary or other arts critics. As Andrew McMurry points out, this may be because '[d]espite its modern mission to decenter texts, authors, and readers while exploring the posthuman possibilities offered up by the open text, literary studies remains disdainful of concepts drawn from fields that a) use mathematics or b) build robots or c) theorize business management.'[238] And yet, as we have seen, systems theory is not simply a field that builds robots; it is both philosophy and approach.

Certainly a systems theory approach also reveals the porosity of the boundaries of our cybernetic imaginary. Perhaps we should not be afraid of comparing animals and machines, the organic and the inorganic, because at the very least these comparisons cast a new kind of light. As Marinetti suggested in 1912, with a reminder of the importance of the inorganic as well as with particular prescience with regard to the notion of animal/machine/code that would become dominant in cybernetics, genetics and linguistics:

> 'Up to now writers have been restricted to immediate analogies. For instance, they have compared an animal to a man or to another animal, which is almost the same as a kind of photography. (They have compared, for example, a fox terrier to a very small thoroughbred. Others, more advanced, might compare that same trembling fox terrier to the Morse Code machine. I, on the other hand, compare it to gurgling water. In this there is an *ever vaster gradation of analogies*, there are ever-deeper and more solid affinities, however remote).'[239]

It is only through this wild analogising, Marinetti concludes, that we can embrace the life of matter. It is through analogy that we can access the material world that we inhabit, and address our own materiality.

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238 Andrew McMurry 'Systems theories and literary studies' in Arnold, Darrell P. ed. *Traditions of Systems Theory: Major Figures and Contemporary Developments* (New York: Routledge, 2014), pp. 261 – 276, at p. 264.

239 Marinetti, p. 57.

CHAPTER 3

Gaia: 'The autopoeisis of the cell writ large'

> '[T]he quest for Gaia is an attempt to find the largest living creature on Earth.'
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> James Lovelock, *Gaia: A New Look at Life on Earth*[240]

> '[W]e cannot look at Gaia as a planetary whole without looking, self-referentially, at ourselves, a part of Gaia, looking at Gaia.'
>
> Bruce Clark, 'Autopoiesis and the Planet'[241]

> 'Planetary physiology … is the autopoiesis of the cell writ large.'
>
> Margulis and Sagan, *What is Life*?[242]

1. Gaia: the blue/greening of the Earth

James Lovelock's 1979 classic text *Gaia: A New Look at Life on Earth* was highly influential in the burgeoning environmentalist movement in both America and Britain, bridging science and society and opening ecological debates out to a newly environmentally conscious public. As with Rachel Carson's *Silent Spring*, which had been published at the beginning of the previous decade, *Gaia* was both instigator and icon of cultural change at the time of its publication, and retains significant influence today in popular ideas about the biosphere and its ecosystems. Gaia features an explicitly developed cybernetics- and complexity-based model of the natural world and the operation of its ecological systems. In giving life to the Gaia theory Lovelock worked with the microbiologist Lynn Margulis, in what could be seen as a pleasing illustration of symbiosis, one of the key themes that their model foregrounds.

In brief, Gaia envisages that biotic individuals interact with their abiotic environment to form a self-regulating complex system that allows the continuation of life on the planet. The most foundational example of this is how the early activity of prokaryotic bacteria (nucleus free single cells which were then the only lifeform on Earth) wholly modified the lifeless Earth, firstly by oxidising its surface and then by enriching the atmosphere with free oxygen, creating the conditions for the development and maintenance of more complex aerobic and eukaryotic life. The Earth's atmosphere, as we know it, is 'highly improbable', indicating

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240 Lovelock, James *Gaia: A New Look at Life on Earth* (Oxford, UK: Oxford University Press, 2009), p. 1.

241 Bruce Clarke 'Autopoiesis and the Planet', p. 59.

242 Lynn Margulis and Dorion Sagan, *What is Life?* (Berkeley: University of California Press, 2000), p. 54.

the presence of some kind of intervention, which we would now identify as autopoeisis.[243] As Lovelock puts it in one of his more controversial formulations, the biota and its environment constitute a single homeostatic system that opposes changes unfavourable for life. In a similar vein, Lovelock explains that Gaia is:

> 'a complex identity involving the earth's biosphere, atmosphere, oceans, and soil; the totality constituting a feedback or cybernetic system which *seeks an optimal physical and chemical environment for life on this planet*. The maintenance of relatively constant conditions by active control may be conveniently described by the term "homoeostasis"'[my emphasis].[244]

Lovelock was able to demonstrate, using a simple mathematical model called Daisyworld, that temperature regulation is an emergent property of the system that arises automatically without any purposeful action as a consequence of feedback loops between organisms and environment. This is not always how his work has been interpreted, however.

One obvious critique of *Gaia: A New Look at Life on Earth* is that it can be read as a return to the earliest incarnation of the ecosystem in conceptualising the entire biosphere as a 'superorganism' – and one, moreover, who is named after a Greek goddess and has a 'complex identity.' The name 'Gaia' was, famously, suggested by Lovelock's friend the novelist William Golding, and it is partly as a result of this name and partly because of Lovelock's occasional habit of referring to Gaia as 'she' that the theory has generated some criticism. In the preface to the first edition, Lovelock issued a disclaimer:

> 'Occasionally it is difficult, without excessive circumlocution, to avoid talking of Gaia as if she were known to be sentient. This is meant no more seriously than is the appellation 'she' when given to a ship by those who sail in her.'[245]

This may be so, but in its popular version at least Lovelock's theory nonetheless incorporates complex notions of personification, agency, and teleology. These ideas are further complicated by Lovelock's 'Epilogue' to the subsequent edition of *Gaia* that was

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243 The idea of the biosphere was first used in the late 19th century by the Austrian geologist Edward Suess to describe the layer of life surrounding the earth, a theory that was subsequently developed by the Russian geochemist Vladimir Vernadsky who saw life as a geological force which partly creates and controls the planetary environment, complicating Hutton's earlier notion of the Earth as a superorganism.

244 Lovelock, *Gaia*, p. 10.

245 Quoted in the preface to the 2nd edition. Lovelock, *Gaia*, p. x.

published in 2000, in which he appears to hint at notions of systemic consciousness (mainly by speculating that human consciousness and intelligence are part of Gaia's overall identity) but he then shies away from the implications of this thinking. These suggestions become particularly unsettling when compounded with Lovelock's theory that the planet 'looks after itself' and the implicit suggestion in much of his more apocalyptic writing that Gaia may prove to be the end of us, rather than the other way around. This is an implication that has been missed by some critics of the hypothesis, who read it as theorising a kindly and self-regulating Mother Nature. In fact Lovelock is suggesting something much darker, within which it is not too far-fetched to detect overtones of vengeance.

These Gaian elements of personification and mythology are coupled with cybernetics and its successor ideas, as informed by narratives of homeostasis and symbiosis, to theorise a political and environmentalist approach to our dealings with the natural world that remains prominent today. Lovelock has continued to develop his ideas into the 21st century and his sometimes inconsistent and often contentious positioning has been challenged by, among others, the prominent evolutionary biologists Stephen Jay Gould and Richard Dawkins (although for different reasons). For example, Gaia cannot be read as an organism that has been selected in Darwinian terms; it is a complex interactive system that features emergence and autopoiesis, yet some readings of the hypothesis, at least in its more excitable versions, do seem to suggest that Gaia is an individual in this way. Nonetheless, it remains a powerful hypothesis and continues to inform ecological debates, popular environmentalism, our wider understanding of the 'ecosystem' concept, and even, it seems, ecological science – although it is not entirely possible to trace the bifurcations of the concept into its 'popular' and 'scientific' incarnations, because these discrete categories do not seem to exist.

Lovelock's Gaia theory began at the very beginning, with the question of the nature of life: when considering how one might best detect life on Mars, Lovelock came to the realisation that the thing to do would be to look for some reduction of entropy, because self-organisation and the resistance of entropy are key hallmarks of life of all kinds. With regard to the problem of recognizing living systems, he says that:

> 'even the new science of cybernetics has not tackled the problem, although it is concerned with the major operation of all manner of systems [...]. Much, indeed, has already been said and written about the cybernetics of artificial intelligence, but the question of defining

> real life in cybernetic terms remains unanswered and is seldom discussed.'[246]

Lovelock makes an important point here: Wiener's foundational text might talk about self-regulating systems of communication and control in the animal and the machine, but it does not first define the animal, which indicates one set of problems with first-order cybernetics when applied to living systems. Lovelock's epistemic moment in the 1960s would have featured a heavy influence on cybernetics and systems theory, largely because in the initial excitement surrounding this work it seemed that a universal theory had been found. There is a sense in Lovelock's first book of the sense of sudden clarity that thinking in systems theory terms must have appeared to offer, after centuries of 'wrongheaded' thinking. The move towards thinking in terms of cybernetics, as Lovelock puts it, was delayed by the inheritance of classical thought processes and the rejection of the circular arguments that inform cybernetics: in cybernetics, 'cause and effect no longer apply, it is impossible to tell which comes first, and indeed the question has no relevance.'[247]

2. Maturana and Varela

In the 2000 edition of *Gaia*, Lovelock indicated that he had first suggested the hypothesis at a meeting in Princeton in 1968, to a dismissive reception.[248] If this is so, it pre-dated the first publication of the theory of autopoiesis in English by four years: autopoiesis is now central to Gaia theory, but it seems that in the early incarnations of his work Lovelock was working on the basis of a vaguer idea, a sense of the reduction of entropy, with no clear vision of the systemic dynamics that might achieve this and no name for the process.

Bruce Clark usefully summarises the relationship that now sits between the theory of autopoiesis and the Gaia hypothesis as a question of levels of organisation:

> 'Autopoiesis and Gaia fit together as interlocking, micro- and macro-modes of systems theory: biological autopoiesis defines the minimal formal requirements for living systems, beginning with the cell, and Gaia captures the "planetary physiology" of the biosphere, for which the atmosphere is the autopoietic membrane.'[249]

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246 Lovelock, *Gaia*, p. 4.
247 Lovelock, *Gaia*, p. 48.
248 Lovelock, *Gaia*, p. 10.
249 Clarke 'Autopoiesis and the Planet', at. p. 59.

Autopoiesis was first articulated by the Chilean biologist Humberto Maturana and his student Francisco Varela in 1971 to describe the process by which a system maintains and reproduces itself. According to the subsequent English language publication of the theory,

> 'The autopoietic organization is defined as a unity by a network of productions of components which (i) participate recursively in the same network of productions of components which produced these components, and (ii) realize the network of productions as a unity in the space in which the components exist.'[250]

That is, autopoiesis is a network of production of components, and those components continuously renew and regenerate the system that produces them.[251] Autopoiesis is defined in contradistinction to allopoiesis, the mechanistic process by which a system produces something other than itself.[252] As such, some of the key features of autopoiesis are its circularity, its recursivity or self reference, and the fact that autopoietic systems are simultaneously operationally closed to, but open to exchange with, their environments. With the initial example of cognition as an autopoietic system, the mind is organisationally closed and self-producing, but open to interaction with the environment in terms of matter and energy, sense data and information; this interaction partly takes the form of feedback (for example, cognition). As with any other ecological notion, autopoiesis had and still has its critics. As a result of its central ideas of self-reference it can be seen as radically constructivist and relativist, and remarks such as Maturana and Varela's assertion that 'we do not see what we do not see and what we do not see does not exist' have, not unreasonably, incurred a certain amount of ire.[253] Its application to social systems, most signally by Nicklas Luhmann, has also been criticised.[254]

Ranulph Glanville glosses autopoiesis as Maturana's attempt to present life as a process of becoming and remaining alive ('auto' plus 'poiesis' translates to 'self' plus 'production'), creating a *mechanism* for the animate and for the autonomy of form living things generate, meaning that:

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250 F.G. Varela, H.R. Maturana and R. Uribe 'Autopoiesis: the Organization of Living Systems, its Characterization and a Model' *Biosystems* 5 (1974), pp. 187-196 at p. 188.

251 Humberto Maturana and Francisco Varela *Autopoiesis and Cognition: the Realization of the Living* (Holland, Boston and London: D Reidal Publishing Company, 2nd edition 1980).

252 Varela and Maturana, 'Autopoiesis: the Organization', p. 188.

253 H. Maturana, H. and F. Varela *The Tree of Knowledge* (Boston: New Science Library,1988), p. 242.

254 Maturana also disliked the extension of the idea of autopoiesis in the work of Eric Jantsch.

> '[t]his may be interpreted, in hindsight, as a machine using an animal metaphor. The change from the mechanical metaphor for the animal to an animal metaphor for the machine is another way of conceiving the difference between first- and second-order cybernetic'[*sic*].[255]

In describing on two separate occasions how they arrived at their hypothesis, Maturana and Varela mention two key factors: defining life, and reading Don Quixote. In an article published in 1974, Maturana and Varela describe a similar jumping off point to Lovelock's; that is, in conceptualising autopoiesis, they were thinking about the definition of life. Their novel hypothesis was that reproduction and evolution were not constitutive features of the living organism, which could only be characterised unambiguously by specifying the network of interactions of components which constitute a living system as a whole or unity.[256] According to Maturana and Varela, then, the very definition of life is that it is something that must be viewed holistically. Autopoiesis is a signal function of this whole. The importance of this for the Gaia hypothesis (as well as for later complexity theory), is evident. Secondly, as Maturana and Varela describe the genesis of the idea, it came from a reading of Don Quixote and his dilemma between the poles of praxis and poiesis, action and creation. As a neologism with no scientific history, autopoiesis supposedly carried no baggage – a somewhat questionable assertion, given the etymology of poiesis, and the fact that the common root of the word with poetry perhaps partly explains its appropriation by literary criticism.[257] A third limb that fed into the inception of autopoiesis was the work of the second-order cybernetician Heinz von Foerster.

Whilst with the increasing interest in complexity theory there is currently a resurgence of interest in the idea of autopoiesis, at the time of its inception autopoiesis was not a mainstream scientific theory, and in ecology at least it is still not mainstream. The historical reason for this is perhaps that during the last decades of the 20th century genetics was the dominant paradigm of biology, which left no room for systems-based thinking of this type; the current reason is that its application to ecological systems has not been convincingly demonstrated (see chapter 5 for more on this).

A further caveat is that autopoiesis is now commonly used to mean self-organising, as the term is used in literary studies and complexity theory, but this is not its original incarnation: Maturana himself felt quite strongly that 'self-organising' was not a correct meaning of the

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255 Glanville, p. 54.
256 Varela and Maturana, 'Autopoiesis: the Organization', p. 187.
257 Maturana and Varela, *Autopoiesis and Cognition*, pp. 16 and 78.

term. If we are to use it strictly in the sense in which Maturana and Varela originally intended it, it would predominantly connote self-production and autonomy. This idea of autonomy, as Varela saw it, could be used to replace Lovelock's more controversial idea of the system as living; instead the system had 'living-like' characteristics, such as autonomy. Margulis offered a similar reframing of Lovelock's animistic ideas.

3. Margulis and symbiosis

Alongside the cybernetics and autopoeisis that formed conceptual cornerstones of the Gaia hypothesis, another central idea is that of symbiosis as a key driver of evolution. Lynn Margulis, who worked with Lovelock, challenged prevalent readings of Darwinian evolution as essentially competitive, emphasising that co-operation, interaction and mutual dependency were equally important to the development of complex life on Earth. Symbiosis can be divided into two main categories, endosymbiosis and exosymbiosis. In endosymbiosis one organism lives within the tissues of another, either in intracellular or extracellular space. Disparate examples of endosymbiosis include rhizobia (nitrogen fixing bacteria that live in root nodules on legumes), single celled algae inside reef building corals, and mitochondria in, for example, human cells that still retain the distinct DNA of their ancestors, and perform the energy conversion within cells that is a pre-requisite to mammalian life. The second category is exosymbiosis, in which one organism lives on the body surface of another, which would include the gut microbiome in humans. The significance of symbiosis in the Gaia theory is evident, as it is in the integral theory of autopoiesis, by which the system and its environment are mutually dependent and co-adapting.

When we turn to the question of how these ideas have played out in literature and literary criticism, a number of examples present themselves. We can separate the Gaia hypothesis into some of its constituent parts for these purposes, namely Gaia as superorganism, autopoiesis, and symbiosis. To take the first of these notions first, as I have mentioned previously, the superorganism idea does not start in the 1970s with Gaia theory: Gaia reframes some much older metaphors and also connotes Clement and Philip's ideas of the complex organism. It is also related to the entomological use of the superorganism, covered in the previous chapter.

Another incarnation of the superorganism idea that borrows something from Gaia and also from the work of Lynn Margulis is the recent popular science characterisation of each

human as a superorganism (in view of the integral nature of that human's microbiome).[258] As Timothy Morton points out, any body also contains millions of bacteria in delicate balance with their host: '"the" body is a palimpsest of symbiotic organisms.'[259] It is questionable where the body ends and the world begins. The employment of the superorganism metaphor in these popular science texts serves to remind us that our notions of the boundaries of the 'self', as well as notions of the unity of the 'self', are inherently unstable. There are echoes here of Stacy Alaimo's idea of transcorporeality, her anti-Cartesian approach to how bodies interact with other bodies; and there are also parallels with later aspects of complexity theory that reframe our notions of borders and boundaries and of open and closed systems.[260] It seems that an old metaphor can be redeployed to accord with contemporary thinking, revealing that contemporary notions were present within the metaphor all along, or, conversely, reminding us that contemporary leanings against dualism and towards holism have a longer history than we think. The ecosystem/ superorganism comparison in effect serves to reaffirm monism, to agglomerate disparate parts into an (arguably) illusory whole and import to it certain properties that, empirically speaking, it appears not to have; whereas the human/ superorganism operates in some respects to question both monism and dualism by unsettling notions of 'self', and emphasising the porosity and imbrication of self and world. If we remember to apply the requirement that a whole must have properties that are not reducible to the properties of its components, this certainly seems to be the case for human bodies – so in fact the employment of the superorganism metaphor in this context simultaneously operates both to reaffirm our sense of self and to destabilise it. It is worth adding that this notion of the human as superorganism and relating it to the Gaia theory recalls the established but now largely discredited practice in ecology of studying microcosms in order to determine how a much larger whole might operate; this practice bears some resemblance to many of the other pattern-detection habits of ecologists that I have outlined, such as discerning parallels between the development of an individual and of a group, and is yet another unstable analogical exercise.

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258 See for example recently published popular science books Jon Turney *I, Superorganism: Learning to love your inner ecosystem* (UK: Icon Books Ltd., 2015), and Rodney Dietert *The Human Superorganism: How the Microbiome Is Revolutionizing the Pursuit of a Healthy Life* (USA: Dutton Books, 2016).

259 Morton, *Ecology without Nature*, p. 108.

260 Stacy Alaimo, *Bodily Natures: Science, Environment and the Material Self* (Indianapolis: Indiana University Press, 2010).

4. Gary Snyder's Gaia: Superorganisms (II)

The Gaia hypothesis has held some fascination for poets such as Gary Snyder and, as another example, the Irish poet Derek Mahon. Sam Solnick offers an analysis of Mahon's ironic poetry in *Poetry and the Anthropocene*, seeking to show how the use of Gaia foregrounds ironies and anxieties within Mahon's work (in particular in his 2008 collection *Life on Earth*).[261] This analysis, whilst always interesting and original, does not seek to unpack the constituent parts of the Gaian superorganism nor the broader ramifications of its underlying holistic philosophy, and I have therefore not relayed this part of Solnick's work in detail here.

Gary Snyder has incorporated the Gaia idea into his work, sometimes by name as in 'Little Songs for Gaia', and sometimes in what appears to be a conflation with 'Mother Nature.' On first reading, 'Little Songs for Gaia', the second part of Snyder's collection *Axe Handles*, again seems suggestive of a relatively uncritical approach to the science and popularised science underlying the Gaia hypothesis.[262] In the first section of the poem, Snyder offers us the idea of a 'slow-paced / system of systems, whirling and turning', and later, the 'whirl of the white clouds over blue-green land and seas/blue-green of bios bow — curve – ', which recalls not only the image of the Blue Marble, its climate systems in dynamic motion, but also Lovelock and Margulis's description of the original blue/greening of the Earth by prokaryotic bacteria, as well as the Buddhist myth of Chuang-tzu looking down at the earth.[263]

The tone of 'Little Songs for Gaia' is ostensibly naive and even kindly, not only in the sentimentalism of these 'little songs' for the living planet, but also in infantilised phrases such as 'cloud soft greys/ blues little fuzzies', and the anthropomorphic depiction of young hens 'just into a life/ of egg-bearing pride' in a world that is 'made for Red Hens.' The capitalised reference to Red Hens recalls the nursery rhyme at the same time as it offers an idealised vision of smallholder farming and happy chickens, which should perhaps alert us to the presence of irony.[264] Snyder appears to be satirising our casting of Gaia as an angry Mother Nature. This is Gaia in her less than scientific incarnation.

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261 Solnick, p. 128.

262 Gary Snyder 'Little Songs for Gaia' *Axe Handles* (Washington, DC: Shoemaker & Hoard, 1983), pp. 47-59.

263 Snyder, 'Little Songs', pp. 49 and 54.

264 Snyder, 'Little Songs', p. 53.

Shortly after the early reference to the system of systems, Snyder appears to cast doubt upon human knowledge and, perhaps, the cognitive reach of science, in the suggestion that the earth is flat. He exhorts us to:

> 'Look out over
> This great world
> Where you just might walk
> As far as the farthest rim
>
> There is a spring, there
> By an oak, on a dry grass slope,
> Drink. Suck deep.
>
> And the world goes on'[265]

The Babylonians saw the earth as a flat disc with mountains around the rim upon which rested the dome of heaven; similarly, in the Egyptian version, the Earth was flat but rectangular, and the sky was the goddess Nut's star-spangled body, arched uncomfortably over the Earth as daily she gave birth to the sun. More recently, for theological reasons Luther and St. Augustine similarly insisted the Earth must be flat.[266] However, as we now know, the Earth is not flat and has no 'rim.' Snyder's lines are explicitly drawing attention to the vanishing point that lies at the far reaches of our field of vision, and how misleading it is, in what seems to be a mocking reference to the limitations of our knowledge and the new fields of knowledge that open up ('and the world goes on') as we journey forwards. The Gaia hypothesis is one more way-marker in this mental landscape of paradigms shifts.

The limitation of our vision is an idea that Snyder returns to some pages later, in the passage quoted earlier in which the 'rim' of the Earth has become a bow or curve, something that is also formally enacted in the fragment 'bios' which suggests a curtailed 'biosphere' at its vanishing point. Vision cannot be trusted: Snyder offers us a reversal of the Earth's colour scheme, with the 'blue of the land, green of the sky.'

As the landscape of the poem develops it leads us into an alarming collision of folk music lyrics, Buddhist chants, linguistics, and popular science, in which the organicism of

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265 Snyder, 'Little Songs', p. 50.

266 John Grant *A Directory of Discarded Ideas* (Sevenoaks, UK; Ashgrove Press, 1981), pp. 44-45.

linguistic evolution is made explicit even as phonemes are exploded. Like Gregory Bateson, Snyder detects a deep underlying homology between speech and plant form:

> 'Deep blue sea baby,
> Deep blue sea.
> Ge, Gaia
> Seed syllable, "ah!"'[267]

Snyder also offers us a deep ecology view of a vanishing set of layers, or perhaps an ecologist's microcosmic analysis of geological time, in which humans are depicted as insects to the trees, just as trees are to the geological landscape:

> 'As the crickets' soft autumn hum
> is to us,
> so are we to the trees
>
> as are they
>
> to the rocks and the hills'[268]

5. Autopoietic poetics

As I mentioned in the introduction to this thesis, there is a small but growing body of literary criticism that draws on the idea of autopoiesis to analyse texts. More often than not, the idea is loosely applied, and often also is used to indicate notions of self-organisation as well as self production, in an extension of Maturana' and Varela's version that carries some really quite significant implications. For example, in his 1991 book *The Textual Condition* Jerome McGann considers texts such as James Joyce's *Ulysses* and the poetry of Ezra Pound as 'autopoietic mechanisms operating as self-generating feedback systems that cannot be separated from those who manipulate and use them.'[269] In McGann's formulation, it seems that the text and the reader together form this autopoetic system. McGann uses the idea of autopoiesis as the basis of his distinction between literary texts and texts that imagine themselves as 'informational', autopoetic texts being paradigms of the interactive feedback mechanisms identified by Maturana and Varela.[270] He explicitly characterises the textual condition of the autopoetic text as an interactive locus of complex feedback operations, drawing attention to a laced network of linguistic and bibliographical codes; we infer that

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267 Snyder, 'Little Songs', p. 54.
268 Snyder, 'Little Songs', p. 51.
269 Jerome McGann, *The Textual Condition*, (Princeton, USA and Oxford, UK: Princeton University Press, 1991), p.15.
270 McGann, *The Textual Condition*, p. 11.

there is a notion of self-organisation here as well as of self-generation.[271] McGann is chiefly employing the idea of autopoiesis as a metaphor, rather than bringing a systems theory point of view to bear on textual or linguistic analysis in any very detailed spirit. It is nonetheless a useful label for focusing ideas about how texts operate within contexts, and for discussing the accumulation of authorial intention, editorial presentation and reader reception: texts are produced over time, they are socially and historically relative, and in their critical production we must pay attention to their relations and relativities.[272]

In a more recent book, Jed Rasula also glances at the possibilities of the idea of autopoiesis in *This Compost*.[273] *This Compost* is a hybrid text, being in part critical appraisal and in part an anthology of poetry that focuses particularly on the Black Mountain poets and their antecedents such as Whitman, Pound, and Zukofsky. Rasula himself asserts that the text 'is not altogether a scholarly project', and there is some justification for this remark in that, as he acknowledges, *This Compost* might be better approached as an instance of 'poet's prose', or the search for 'ecology in the community of words' (a phrase that I have already pointed out) than an academic text.[274] Rather than logical argument, Rasula offers a series of themed reflections and syntheses of thematic congruencies in poetry, interspersed with a fragmentary collage of sometimes unattributed poetry. In this exercise, Rasula briefly uses autopoiesis to discuss the idea of work that corresponds to no prior plan, scheme or blueprint: '*it is its own preview and afterthought*' (italics in the original).[275] He continues that 'Western aesthetic sensibility has been so sedulously trained in the dialectic of repetition and recognition – rather than motion and cognition – that it is literally stupefied at the prospect of anything different.' And there, disappointingly, he leaves the idea. Both McGann and Rasula's use of autopoiesis is nearer to a metaphorical application of the idea than to a systems-based analysis of text or the function of language. They simply seem to be using it for the suggestive possibilities of the idea. These examples indicate that the idea of autopoiesis is not as useful in describing texts and textual systems as some of the later applications of complexity theory. It might, for example, usefully describe the cultural production of text, and cultural feedback on text, but, to paraphrase Dana Phillips, at best it is a vague metaphor and at worst a misleading one. Don Byrd also engages with autopoiesis in *The Poetics of the Common Knowledge*, in which he ties it to theories of language, but his

271 McGann, *The Textual Condition*, pp. 12-13.
272 McGann, *The Textual Condition*, pp. 93.
273 Rasula, *This Compost*, pp. 4 and 168.
274 Rasula, *This Compost*, pp. xiii and 7.
275 Rasula, *This Compost*, p. 168.

take on Maturana and Varela's work is limited and does not account for developments in the later theory of autopoeisis.[276] I will say more about autopoiesis and its development in chapter 5. When we re-associate autopoiesis with its original emphasis on cognitive systems, it becomes more interesting in its application to art and literature. It is worth mentioning at this stage that very few have focused on symbiosis in literature, or even in ecology. The philosopher of science Kent A Peacock characterises symbiosis as a neglected link between ecology and evolution.[277] There do seem to be possibilities for literary interpretation here, along the lines of the 'rhizomatic', as that concept is employed by the French philosophers Gilles Deleuze and Félix Guattari. The 'rhizomatic' is based on a holistic metaphor drawn from the botanical rhizome, a modified symbiotic subterranean organism that sends out roots and shoots, to describe theory and research that allows for multiple, non-hierarchical entry and exit points in data representation and interpretation.[278]

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276 Don Byrd *The Poetics of the Common Knowledge*. See Chapter 5 'Symbolic Symbols', pp. 263–370, in particular.

277 Kent A Peacock, 'Symbiosis in Ecology and Evolution' in M. Gabbay, Paul Thagard and John Woods. Vol. 11, *Handbook of the Philosophy of Science* (Oxford, UK and Massachusetts, USA: Elsevier, 2011), pp. 218–250.

278 See for example Adam Dickinson, 'The Weather of Weeds: Lisa Robertson's Rhizome Poetics ', *Rhizomes,* 15 (2007) <http://www.rhizomes.net/issue15/dickinson.html> [accessed 18 December 2012]. See also M. Niemann, 'Rethinking Organic Metaphors in Poetry and Ecology: Rhizomes and Detritus Words in Oni Buchanan's 'Mandrake Vehicles.' *Journal of Modern Literature,* 35 (2011).

CHAPTER 4

‘A poetry of observed relationship’: observation, objectivity and (inter)subjectivity in the radical ecosystems of Colin Simms

> ‘A poem is really a kind of machine for producing the poetic state of mind by means of words. The effect of this machine is uncertain, for nothing is certain about action on other minds.’
>
> Paul Valéry, *Poetry and Abstract Thought*[279]

1. The observer in the machine

Another aspect of second-order cybernetics, alongside its development into the Gaia theory in ecology, is its acknowledgement of the existence of the observer within the system that is being studied, something that would have been anathema to much early 20th century science before advances in quantum mechanics, the realisation of uncertainty, and the operation of the observer effect at a subatomic level forced scientific thinking into new lines. Second-order systems theory acknowledges that in fact the observer is part of the system that is under scrutiny and can itself be studied; this is just one more type of circularity that is endemic to systems theory’s concerns. Unlike other fields that acknowledge observer inclusion, second-order cybernetics does not necessarily treat it as a problem to be minimised.[280] In effect this means that the observer and the observed undergo a simultaneous and ongoing switching of roles, or perhaps, more accurately, that both occupy both roles at the same time. Second-order systems theory is one of the first fields brave enough to challenge the previously dominant paradigm of attempted ‘objectivity’ within science.

The applications of this thinking to any developed notion of ecology are clear; we cannot deny our own implication within ecological systems, and we have to acknowledge the limitations of our observations. This parallels our place within our own systems of representation: there is no outside to language, as is often pointed out. This fact has given

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279 Paul Valéry, ‘*Poetry and Abstract Thought*’ in John Cook ed., *Poetry in Theory: An Anthology 1900 – 2000* (Massachusetts and Oxford: Blackwell Publishing, 2004), pp. 237–243.

280 See Glanville, p. 60.

rise to a certain degree of ecocritical anxiety. Timothy Morton suggests at the beginning of *Ecology Without Nature* that we have to come to terms with the fact that there is no metalanguage – there is nowhere outside a signifying system from which to pronounce upon it, which is problematic for criticism because it is compelled to sort things out without the 'safety net of distance.'[281] Language is one of the more powerful pieces of equipment that mediates between us and the Earth.

Although Morton does not point it out, there is of course no 'safety net' in a 'distancing', there is only inaccuracy. There ought to be an acceptance that far from reifying 'nature', as a number of ecocritics anxiously suggest, language *is* part of nature; it is just one 'level of organisation', to use the language of complexity theory, among many. Language is also *natural*: as Gary Snyder puts it, 'Language is a mind-body system that coevolved with our needs and nerves.'[282] There may or may not be a mind-independent and representation-independent reality ('common sense', that most dangerous of the senses, suggests that there probably is) but it really doesn't matter, from our point of view. As Solnick points out in an excellent discussion of Ted Hughes, we need to accept that technicity – including language – mediates everything. Instead of trying to find a way round it to a chimeric world free from mediation, any literary attempt to capture a primordial sense of corporeality must negotiate the technical.[283]

Part of this negotiation is found in the attempt both to refresh and to interrogate language. Performing new ways of representing the complexity of the Earth and discovering new ways of revealing the hidden values in our linguistic and mythical ideologies specifically by way of the estrangements of poetry is one of the key themes of this thesis. This does seem to be a space where innovative poetry in particular excels (conversely, Morton's attempt to refresh key ecocritical concepts by renaming them is not always helpful, as he himself partly acknowledges).[284] This refreshment and illumination of language is something that is performed particularly well, I will argue over the course of this and the next chapter, in the poetry of Colin Simms and Lyn Hejinian.

This chapter of the thesis, as outlined in the introduction, seeks to bring to bear a textual analysis in a reasonably sustained way using second-order cybernetics, and its forward-

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281 Morton, *Ecology Without Nature*, pp. 26-27.

282 Gary Snyder 'The Etiquette of Freedom' in *The Practice of the Wild: Essays by Gary Snyder* (San Francisco: North Point Press, 1990), pp. 3-24 at p. 17.

283 Solnick, p. 85.

284 Morton, *Ecology Without Nature*, p. 30: 'My attempt to break the spell of language results in a further involvement in that very spell.'

reaching tendrils of early complexity theory. In bringing the themes of second-order cybernetics to bear on the poetic text, and in particular its challenge to objectivity in science, I will also seek to document how some of the problems that second-order systems theory seeks to resolve have long been explored in literary and wider discourse, such as Rilke's notion of the 'Open', and how some solutions to these problems have already been proposed, although wrapped up in the rubrics of philosophies with other names. I include Rilke's idea of the 'Open' not only because Simms mentions Rilke in his text, but also in particular because it seems to me a motif that expresses very well the peculiarly persistent longing for an existence outside our systems of representation that bedevils science, art, and ecocriticism.

As we turn to the poetry, it is worth bearing in mind some of the criticisms that might apply to this type of analysis. As Ranulph Glanville points out, opponents to second-order cybernetics argue that it proposes a solipsistic way of looking at the world: the inclusion of the observer makes our knowledge of systems subjective and open to 'wishful thinking.' This, Glanville argues, is not the case; it demands that we test the descriptions we generate.[285] That seems to suggest a place for poetry and its cognitive processes.

2. Colin Simms's 'poetry of observed relationship'

Although Simms's landscapes are drawn variously from northern Britain, North America and even Afghanistan, it is to Northumberland that he repeatedly returns. These landscapes and their inhabitants are explored by way of linguistically playful and unpredictable techniques (including puns and other play on the physical aspects of language), a series of glimpses of connected etymologies, and a form on the page that is riddled with gaps. Simms repeatedly confounds the reader's expectations, whether through the deliberate subversion of expectation that operates in his non-syllogistic phrasing, or in his use of surprising assonances and other resemblances between words that focuses our attention on the connections between words and words, on the more tenuous and arbitrary links between words and objects (rather than on those words or objects themselves), and on the surprising ways in which those connections might work. His preoccupation with local dialect is highlighted in some of his work. Other work that is less regional in tone nevertheless features various types of resistance to the standardisation of contemporary language, often principally visible in Simms's use of neologisms, archaisms, and words drawn from the

[285] Glanville, p. 49.

diverse lexicons of science, technology, music, art, taxonomic classification and mechanisation. These registers are often problematised even as they are invoked.

It is significant that Simms is a less well known British poet writing mainly in the later part of the 20th century. In company with other regional poets of this time producing experimental work that takes nature and ecology as its subject matter – a type of work that Harriet Tarlo has characterised as 'radical landscape poetry' – Simms's work has been marginalised by the literary establishment. There are reasons for this that relate specifically to Simms's work, such as the fact that it sometimes appears 'unfinished' and includes aspects that seem clumsy or crudely expressed, the fact that his 'meaning' is sometimes elusive, and the fact that his concerns might appear (I think misleadingly) to be exclusively local or regional. There are also broader reasons, such as the fact that reading ecologically orientated poetry was not a mainstream trend at a time when the prevailing zeitgeist celebrated the urban, the global, and the technologically advanced.

One consequence of this marginalisation is that there is little critical material on Simms's poetry. Some interest in his work has been demonstrated recently by critics such as Harriet Tarlo, Leo Mellor, Andrew Duncan, and Amy Cutler, and Bunting scholars occasionally show a passing interest, but the recently proposed title 'The Salt Companion to Colin Simms's was cancelled before publication, and there are no indications that his work is likely to be studied in the near future.[286] Nevertheless, I want to suggest that Simms's work does deserve critical analysis and that, in some respects, it is unique among its contemporaries. In fact, I will go on to suggest in the body of this chapter that two of the very aspects of Simms's work that have rendered it less popular, namely the patchy and sometimes 'unfinished' nature of it, and the quality of elusiveness or difficulty, are crucial indicators in terms of what his poetry attempts to achieve and the wider significance of his poetics. These factors are the necessary by-products of the complex scope of Simms's investigations and his always interesting integration of the cultural and theoretical with the experiential encounter with the natural world.

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[286] See for example Harriet Tarlo, 'Radical Landscapes: Contemporary Poetry in the Bunting Tradition', in *The Star You Steer By*, ed. by James McGonigal and Richard Price (Amsterdam, Atlanta, GA: Rodopi, 2000), pp. 149-80., the introduction to Harriet Tarlo, *The Ground Aslant: An Anthology of Radical Landscape Poetry*, (Exeter, UK: Shearsman Books, 2011). pp.7-18, Leo Mellor, 'The Unburied Past: Walking with Ghosts of the 1940s', in *The Oxford Handbook of Contemporary British and Irish Poetry*, ed. by Peter Robinson (USA: Oxford University Press, 2013), pp. 57-76., Andrew Duncan, *Centre and Periphery in Modern British Poetry*, (Liverpool, UK: Liverpool University Press, 2005)., and Amy Cutler, ''Whitby Is a Statement': Littoral Geographies in British Poetry', in *Poetry & Geography: Space and Place in Post-War Poetry*, ed. by Neal Alexander and David Cooper (Liverpool, UK: Liverpool University Press, 2013), pp. 120-33.

In addition, Simms's work lies within a number of poetic traditions that lead very directly back to Basil Bunting and Charles Olson, and ultimately back to Ezra Pound, William Carlos Williams and Louis Zukofsky, as well as laterally to include poets such as Richard Caddel. These influences and resonances are most often apparent formally, and in the case of the links with Bunting and Caddel are also found in a shared subject matter and a celebration of regionality. Simms's incorporation of formal and substantive innovations that develop the ideas of these earlier poets is enhanced by a shared sensitivity to the material characteristics of language and to its etymology. An awareness of all of these resonances is key to approaching his work. It is worth noting that Simms's modernist practices are more defining in terms of his poetry than the inherited characteristics of the other tradition within which his work sits, that of more conventional forms of landscape or nature writing. This is not to say that the experimental rather than the ecological heads Simms's list of concerns, but rather that he uses the former to illuminate the latter, and that this is why his poetry is important: his concern with both the philosophical and the practical aspects of ecological knowledge is played out in a complex integration of aesthetic, poetic, linguistic experiments that achieves a more integrated mode of knowledge even as it interrogates the limits of human perspective. As distinct from its predecessors in the nature poetry tradition, Simms's work seems rather to fall within the elusive, mainly contemporary category that is sometimes termed ecopoetry, if by that we mean poetry with a strong ecological message or awareness that employs an experimental interrogation of language to investigate the natural world and our implicit attitudes towards it.[287]

All of this is further complicated – and even, perhaps, made possible – by the additional dimension that Simms brings to his poetry as a committed amateur naturalist. In addition to his book *Lives of British Lizards* Simms wrote numerous articles and letters for publications ranging from the *Rotherham Naturalist* to *Nature*, often dealing with the same themes we find in his poetry: otters, martens, wolverines, gyrfalcons, lizards, and wind erosion, for example.[288] Simms also contributed input to others' scientific papers, such as the data on the haplotypes of English pine martens that were used in two studies on the distribution of types of pine marten.[289] His detailed, rigorous observational knowledge of the natural world as an

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287 See the conclusion for a longer discussion of 'ecopoetry'.

288 Colin Simms, *Lives of British Lizards*, (UK: Goose & Sons, 1971).

289 C. J. Kyle, A. Davison, and C. Strobeck, 'Genetic Structure of European Pine Martens (Martes Martes), and Evidence for Introgression with M. Americana in England', *Conservation Genetics*, 4 (2003)., p.181; and Angus Davison and others, 'Mitochondrial Phylogeography and Population History of Pine Martens Martes Martes Compared with Polecats Mustela Putorius', *Molecular Ecology*, 10 (2001)., at page 1481.

amateur naturalist is brought to bear on his poetry, as is a more formal knowledge acquired through the methods and analyses that he borrows from the world of science.

In addition to the scientific materials that he imports into his work, Simms also draws extensively from the indigenous North American spirituality and cultural traditions that he studied during his time there, and which ultimately he 'adopted'. Whilst the attempt to engage with a broader cultural range of materials brings a welcome depth and richness to the poetry, affords a less narrow worldview than would otherwise be the case, and brings disparate discourses into a productive dialogic tension, this is nonetheless a problematic aspect of his work. As a British poet Simms's background lies outside these cultural traditions and no matter how thoroughly he has studied them he can only employ them in his work by way of a literal linguistic translation as well as a wider cultural translation. There is also a particularly difficult set of power relations in play, given North America's colonialist history and the project of cultural assimilation. Simms's importation of these materials into his work entails the danger of misinterpretation by the poet, however unintentional, which is further complicated by the fact that Simms's readership is most likely to be European and, more narrowly still, British. There is a corollary danger that mutated versions of indigenous narratives might ultimately modify or replace originals (a danger which would of course be greater if Simms's work was more widely read than is currently the case). Simms himself does not explicitly acknowledge these potential layers of slippage, which is perhaps odd given his scepticism regarding the received wisdoms of his own cultural and scientific traditions, but as critics it is incumbent upon us to note these issues.

I will argue that Simms's sense of the complexities of ecosystems, which presumably arises from his meticulous observational work and analysis, actually informs the complexities of his poetry, and even vice versa. Part of Simms's endeavour seems to be to integrate the types of knowledge that inhere in these very different discourses, however imperfect this results of this exercise may be, and to use this hybrid to illuminate the nature of natural and textual complexities. So how might this poetry offer a cognitive space and/or process that enables us to conceptualise these difficult ideas?

3. Disassembling the wolverine: the problem of representation

> ‘Its [sic] a fallacy of our time that our ‘knowledge’ has us understand
> so we can ‘automatically’ communicate, co-operate’[290]

So writes Colin Simms in ‘Carcajou’, a long poem on the wolverine that was originally published in 1987 in *Eyes Own Ideas* and subsequently collected in *The American Poems*.[291] Simms, it seems, is particularly suspicious of systems of representation and knowledge. The first line of the extract above can be read in isolation as emblematic of Simms’s mistrust of human approaches to the natural world: “its [sic] a fallacy of our time that our ‘knowledge’ has us understand.” Simms’s use of scare quotes around the word ‘knowledge’ reinforces the critical tenor of his remark, suggesting incredulity and even, perhaps, a certain contempt towards the garnering of ‘facts’ and ‘theories’ that constitute so-called knowledge. When the extract is taken as a whole, an equally characteristic scepticism becomes apparent that the purpose or the effect – it can be read either way – of gaining ‘knowledge’ is to enable ‘automatic’ co-operation and communication. Yet in the face of these limitations, as Simms points out, our frustrating attempt both to gain and to express ‘knowledge’ never stops, and cannot stop, being as necessary and as universal as digestion: “I am still chewing through true, too,” he tells us.[292]

‘Carcajou’ is one of many works in which Simms ‘systematically’ applies innovative poetic practice in an experimental tradition as a means to explore so-called knowledge, in order to comprehend our encounters with other animals and the consequences of decreasing biodiversity. As part of this practice, Simms hybridises approaches drawn from discourses as diverse as Western empirical science and the indigenous American spirituality and animistic belief-systems that give his poem its title. In Innu myth the eponymous Carcajou is a trickster, but also the creator of the world; by marked contrast, in Western biology the wolverine is a large, shy, unremarkable, carnivorous mammal of the mustelidae (weasel) family, found mainly in Alaska, Canada, and Siberia, whose population is in decline owing to trapping and decreasing habitat. This decline is significant because, as Zielinski and Kucera point out in their study of the wolverine, the integrity of an ecosystem may be

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290 Colin Simms ‘Carcajou’ *The American Poems* (Exeter, UK: Shearsman Books, 2005), pp. 35-45, at p. 43.

291 Simms ‘Carcajou’ p. 43.

292 Simms ‘Carcajou’ p. 43.

measured by the health of its vertebrate carnivore populations.[293] In his capacities as both naturalist and poet, Simms extensively engages with the question of how, from our implicated position within ecological systems, we can best understand these impacts upon the nonhuman, and the related question as to how our so-called 'knowledge' plays a part in the physical dynamic.

Whilst Simms's criticism of 'knowledge' and its communicability is pithy to the point of bluntness, even banality, in the example with which I began, the question of what it is to know and of how 'knowledge' might be communicated generally receives a more nuanced and successful treatment in his work. Simms's exploration of the nature of knowledge is, in general, aesthetically, philosophically, and scientifically informed. As part of his exploration of knowledge, he offers a sustained engagement with the knotty relationship between the experiential and the conceptual that informs our cognitive processing, and with the embodied nature of thinking, an engagement that constantly seeks to circumvent Cartesianism yet which nonetheless acknowledges the recurrent separation that Simms cannot altogether excise between subject and object, and nature and culture. In 'Carcajou' Simms grapples persistently with the problematic but ever present necessity of a pre-existing "imagined-scheme-of-things" into which one fits one's observations, a linguistic medium and a set of conceptual schema that together we must use to represent experience to ourselves in order to gain 'knowledge,' and whose anthropocentrism inevitably infuses our perspective:

> our starting place the Given Word
>
> before we know its prejudice Are you bear or weasel, wolverine,[294]

Towards the beginning of "Carcajou," Simms suggests that in order to engage imaginatively with the elusive wolverine we must first 'listen for a tune.' He invokes *Le Loup,* one of the *Symphonic Fragments* of the modernist composer Dutilleux, as one possible space of mental preparation for his engagement with the wolverine, as though Dutilleux' homage to the wolf could render Simms's (biologically more or less unrelated) wolverine somehow more accessible to its observer:

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293 Zielinski, William J., and Thomas E. Kucera (eds.). *American Marten, Fisher, Lynx and Wolverine: Survey Methods for their Detection* (General Technical Report PSW-GTR-1571995). Albany, CA: Pacific Southwest Research Station, Forest Service, United States Department of Agriculture, 1995, p. 1.

294 Simms 'Carcajou' p. 37.

you, Carcajou, only just recognised and before we know you

we listen for a tune

to engage being out-of-sight so much we require a ritual for a fitting-in

Dutilleux' *Symphonic Fragments*, fragmented

Le Loup might be so augmented

where you will be in our imagined-scheme-of-things[295]

Here, Simms is proposing that we find it necessary to attempt to filter the otherwise incomprehensible phenomenological experience of the animal encounter through a culturally-inflected artefact such as music, and, moreover, that this cultural filtering is always already present in the observer's mind, because it takes place during the very initial moments of the encounter and "before we *know* you" (my emphasis). Not only that, but the *Fragments* are 'fragmented': the musical medium must itself be mentally re-represented and fragmented before it can usefully be employed to elucidate the wolverine encounter/experience. There is also a double-representation in play here, because the *Fragments*, as a way of conceptualising the encounter, are themselves subsequently represented or transmitted through the medium of Simms's poetry. We 'think' in music; we 'think' in poetry. This might unite culture and nature by processing them alongside one another, but it also foregrounds that fact that our perspective on nature is circumscribed; here, cognition occurs by way of the process of representation and re-representation, and 'knowledge' of the wolverine exists only within that cognitive framework. At first glance it seems that Simms is reprising the basic truth that we cannot circumvent representation and access the 'real', even as he continues to yearn for "encounter before imagination" and advocates the 'reality' that we can learn directly from 'the animal' in place of "image or abstraction".[296]

Of course, the ecocritical perception that representation is problematic stems from its mediating properties. The language that shapes our representations and impedes or qualifies our access to the real is strewn with slippages, stochastic connections, and hidden values. Simms displays an ambivalence to these aspects of language, at once making extensive and playful use of a lexicon drawn from particularly culturally 'thickened' discourses of science and the arts, whilst simultaneously – and perhaps quixotically – seeking to interrogate these

[295] Simms 'Carcajou' p. 37.
[296] Simms 'Carcajou' pp. 43-44.

frames of reference from within.[297] For example, in 'Carcajou' Simms uses the poetic medium to explore the types of knowledge implicit in language that determine our conceptual relationship with the animal *ab initio*. This is exemplified in the type of linguistic and mental play referred to above that connects Dutilleux' *Le Loup* (wolf) with Simms's 'wolverine,' a connection that suggests that a wolf is somehow an appropriate, even illuminating, mental correlate for a wolverine. At the same time as making this (questionable) wolf/wolverine comparison himself, Simms also draws our attention to the capacity of language itself to act as both a sort of cultural register or record (the etymology of 'wolverine' does come from the same Saxon stem 'wulf' as the word 'wolf' – Simms's wolf/wolverine conflation is not a new one), and, in consequence, as a reinforcement of received ideas.

The wolverine has another name in the poem too, 'Carcajou', and Simms's use of that name also draws our attention to another set of values concealed within words, incorporating as it does the connotative and linguistic implications of using a French name for the wolverine that is derived from its Innu name (Kuekuatsheu). That is to say, the name 'Carcajou' carries a certain amount of connotative baggage from its French and Innu origins. At the same time, the poetry calls attention to the French renaming of the Innu wolverine as a colonialist act. The wolverine's very name is ultimately derived from a local language and culture that, like the wolverine, is itself in decline – even endangered. In Simms's poetry, 'Carcajou' figures as a haunting invocation of many things that are in the process of being lost. From his implicated position within colonialist traditions, it may be that Simms cannot understand or express indigenous North American traditions or narratives with depth, but his work can and does call attention to one of many instances of assimilation and disappearance.

Simms brings a similar level of inquiry to bear on the reductionism of scientific taxonomy as he does towards other naming conventions. He lists fourteen different aliases, both scientific and colloquial, for the wolverine and its close relatives, which he seems to suggest are 'just one species', drawing attention to how we struggle with identification:

> Mustela barbata, viverra vittata, Taira mustelata, Mustela gulo, Gulo gulo
>
> Gulo luscus, Cub hylaeus, Gubo luteus, Cub biedermanni, Cub wachei,
>
> Cub katschemakensis, Gulo bairdi, Gulo neidecki, Gubo audoboni[298]

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297 Simms 'Carcajou' pp. 43-44.

298 Simms 'Carcajou' p. 38.

In fact, these animals belong to more than one species, not 'just one', although they are all of the same biological family. Some of them are alternative names for the wolverine itself, and some of them resist interrogation, possibly being Cree names. This seems to indicate Simms's thoroughgoing suspicion of taxonomies of all kinds, and most particularly those based upon the skewed morphologies of science that, in Simms's view, seem to operate as an apparatus of biopolitics.[299] Indeed, it may even be that Simms is doubtful of the very category of 'species.' The net effect of all of this is to suggest that the wolverine's essence or identity eludes the biologist particularly, but also human understanding, framed in linguistic taxonomies, more generally.[300]

Simms also uses the reframing mechanism of collage, or 'entropological' recycling, juxtaposing fragments that seem to be drawn from the 1953 publication 'Birds and Mammals of the Sierra Nevada' (such as 'omnivorous, the wolverine') with commentary and materials drawn from other sources, including what seem to be the accounts of other earlier naturalists, in order to reveal the anthropocentric dimensions always latently present within our linguistic and conceptual schemes.[301] The effect of Simms's use of this technique is to deconstruct, characteristic by characteristic, the earlier naturalists' descriptions of the wolverine. The recontextualisation of these materials, their alienation and dislocation, operates to reveal the implicit value judgments and subjectivity that inhere in loaded words such as 'vicious,' 'destructive' and 'untameable', and to create a newly emergent order of knowledge. In his disassembly of the naturalist-constructed wolverine, Simms's methods somehow seem to resemble the artificiality of laboratory methods, where 'organisms in situ became less real than their disassembled parts,' but Simms's purpose is different: he seeks to replace the naturalist's wolverine with his own cumulative (but, of course, equally subjective) image of the Carcajou who 'suffers so to deceive science.'[302]

Simms's decision to write 'Carcajou' to record the wolverine encounter, coupled with the poetic choices he makes, indicates a belief that poetry is itself a legitimate mode of analysis of observational data, one that makes use of language – in all its slippery, complex glory – as the cognitive enabler that it undoubtedly is, at the same time as the 'literariness' of that poetry is able to interrogate the intrinsic assumptions, attitudes, and other concealed epistemic and social material that language contains, in a way that other modes of

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299 The question of the genuine applicability of the biopolitical regime to the nonhuman animal is the subject of some debate, which is unfortunately outside the scope of this thesis. See, for example, Wolfe (2012).

300 Simms 'Carcajou' p. 38.

301 Simms 'Carcajou' p. 37.

302 Kohler, p. 3, and Simms 'Carcajou' p. 38.

representation cannot. For Simms, writing poetry at once utilises *and* interrogates diverse modes of thought and types of 'knowledge,' and in so doing creates something that is more than the sum of its parts.

4. The Open

The anxiety over representation and 'knowledge' in Simms's work parallels Rilke's figuring of humanity's predicament, trapped in a permanent relation of spectatorship and desire by virtue of our mediating representations and unable to access the Open (the human condition is presented here in contradistinction to *die Kreatur*):

> 'With all its eyes the natural world looks out
> into the Open. Only our eyes are turned
> backward, and surround plant, animal, child
> like traps, as they emerge into their freedom.
> We know what is really out there only from
> the animal's gaze; for we take the very young
> child and force it around, so that it sees
> objects – not the Open, which is so
> deep in animals' faces. Free from death.
> We, only, can see death; the free animal
> has its decline in back of it, forever [...]'[303]

It is worth quoting Eric Santner's gloss on Rilke's point because he puts it so well:

> 'Man is forever caught up in the labor of the negative – the (essentially defensive) mapping and codification of object domains that allow for certain sorts of desire and possession but never what Rilke posits as the unimaginable enjoyment of self-being in otherness manifest by the creature.'[304]

Rilke's originary version of the Open is useful for approaching Simms's poetics. Simms complicates and problematises Rilke's notions of the Open and the human/nonhuman and in so doing reconfigures our concepts of both poet and wolverine. Of course, Rilke's human/creaturely dualism has been critiqued and greatly extended by Western thinkers throughout the 20th and 21st centuries, in ways that are too extensive to describe here.

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303 Rainer Maria Rilke, 'The Eighth Duino Elegy', trans. Stephen Mitchell, in *Earth Shattering: Ecopoems*, ed.Neil Astley (UK: Bloodaxe Books, 2007), p. 39.

304 Santner, Eric. *On Creaturely Life: Rilke, Benjamin, Sebald* (Chicago: University of Chicago Press, 2006), p. 2.

Nonetheless, its long genealogy tends always to retain problematic elements of essentialism and human exceptionalism, and indeed, an oppositional mode of delineating the human and nonhuman persists even in those more recent analyses that purport to dissolve it.[305] The human/ nonhuman binary continues to be re-delineated and re-inscribed, whether overtly, through a recurrent focus on our supposedly unique capacity for language, representation, 'reason,' or world-building, or implicitly, when differences are ostensibly put aside in favour of a focus on similarities (such as material embodiment and our consequent vulnerability and shared capacity for suffering) but nonetheless quietly play on as background music.

What is less prevalent among these thinkers, so concerned with drawing ontological distinctions and/or resemblances from the basic starting point of what humanity can do, is an examination of the animal capacity for representation, an exploration of the potential for forms of arbitrary semiosis (if not quite language) in some nonhuman species. The absence of this capacity in the nonhuman is traditionally assumed, by Western thinkers at least, but not proven. Similarly, there is an unsubstantiated but lingering presumption against nonhuman 'self-awareness.' Yet recent research increasingly points towards the existence of some semiotic capacities and abilities in certain nonhuman species, notwithstanding apparent differences in quantity or type from human language.[306] This seems to cast doubt both on our persistent depiction of the nonhuman as purely 'instinctive,' 'reactive,' and lacking in any sophisticated cognitive capacity, and on our own flattering self-portrait at the 'apex' of some putatively teleological evolutionary 'progress' and separation from the nonhuman. It is worth recalling the obvious point that drawing comparisons on the basis of a representational or semiotic capacity is itself an inherent privileging of that on which we most pride ourselves. Comparisons based on examining those capacities among nonhuman species that exceed or differ from our own seem to be less prevalent (these capacities include, for example, the magnetoception of molluscs and birds, and the extensive olfactory abilities of dogs). It is perhaps problematic to assert that these skills are qualitatively 'mechanical' or 'instinctive,' in a way that our cognitive and linguistic capacities appear not to be (and yet whose provenance, after all, we remain unable to elucidate or explain); some of these nonhuman abilities appear to have a quasi-representational or signifying capacity,

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305 This is particularly the case in those investigations of the concept, such as Anat Pick's, that (I think problematically) privilege its Western theological dimensions and hence import a substantial set of anthropocentric ideologies. See Anat Pick *Creaturely Poetics: Animality and Vulnerability in Literature and Film* (New York: Columbia University Press, 2011).

306 See for example Addessi et al. 'Preference Transitivity and Symbolic Representation in Capuchin Monkeys (Cebus apella).' *PLoS One* 3.6 (2008). Accessed online 28/01/2016 <journals.plos.org/plosone/article?id=10.1371/journal.pone.0002414>, at p. 6.

with all the appearance of communication and the production of meaning, above and beyond any purely receptive sensory function.

Colin Simms is uniquely placed, in view of his scientific background coupled with an adopted spirituality derived from that of indigenous Americans, to take issue – in his idiosyncratic fashion – with these anthropocentric assumptions about a lack of signifying capacity and 'self-awareness' in the nonhuman. At times, Simms's work seems to anticipate more recent science. At the same time, it also serves to remind us of those significant cultural traditions that take a very different view of the 'animal' from the Western tradition within which much of our ecocriticism sits. In the most extreme version of Simms's radical re-positioning outside received philosophy, Carcajou appears to address his observer directly:

> you say : don't you wish you'd know my scent in taste
>
> my cunning no waste rich lingual lingo accents lingering
>
> you who, sauntering, fit my footprints as you go to come. "You are older
>
> but I am colder where you beat trails I've been before"
>
> out of stimulation
>
> the evolution we are all in
>
> out of a dark winter sky to sensitivity is secondary skin
>
> out of a glade a made
>
> space in tall trees teased by wind "I've shown the way.
>
> I am with you often and I know you you change your form to me and then we'll see"[307]

There are several ways that we can read the wolverine's acquisition of a 'voice' here. On an initial reading, the more problematic aspects of the passage are clear: Simms lays himself open to a potential charge of anthropomorphism, and, indeed, to a related charge of a dramatic and paradoxical act of prosopopoeia, appropriating or replacing Carcajou's animal 'voice.' Here, poetic observation might feature as a giving as well as a taking, but as a

[307] Simms 'Carcajou' p. 41.

dubious form of giving that unhelpfully endows the nonhuman with additional and imaginary characteristics.

Yet I think that there are other, perhaps more thought-provoking, dimensions to Simms's apparent ventriloquism. Firstly, of course, we could read this passage as depicting Carcajou as a type of dream spirit or totem, showcasing Simms's Innu-derived notions of animism and animal ancestry. I have already mentioned the depiction of Carcajou as world-creator, which features a nonhuman animal not in a created mode of becoming, but as an agent in its own right and as creator, in what is to us a surprising reversal of Western cultural norms. It is also worth remembering that, according to broader Cree traditions, all things have a form of spirit or soul (in Imuktitut, anirniq, also meaning breath), that is comparable in both human and nonhuman. This foregrounds forms of 'knowledge' or belief-system pertaining to our relationships and provisional commonality with the nonhuman that do not sit comfortably within Western traditions, but which nonetheless have validity. Of course, this can also be figured as another misappropriation or replacement of voice and narrative – in this case the voices of the Innu, possibly in a naive (and suspect) spirit of attempted 'authenticity'.

Moving beyond these points and picking up on my earlier query as to whether animals might be found to have signifying capacity, Simms is perhaps not seriously suggesting that the wolverine can speak, nor that he/it has a sophisticated form of language (such as poetry). Yet, nonetheless, this imagined address by the animal to the poem's lyric subject and, by extension, to the reader, somehow seems to make the wolverine's use of language thinkable and at some level conceptually *possible*, which moves Simms's position considerably away from those philosophies that perceive distinctions based on language, representation, and 'reason**,**' stretching from the work of Aristotle, through Descartes, Kant, and Heidegger.

Additionally, in a more subtle exploration of nonhuman signifying capabilities, Simms here presents the 'lingering' 'accents' of scent and taste as though they *are* a language, here a 'rich lingual lingo.' This scent/taste 'tongue', moreover, is a language that is alive with nuances, and that mediates between animals: Simms is calling attention to other sophisticated modes of communication that lie beyond (or perhaps before) words. In a later passage the scent/taste language, again described in Carcajou's own 'voice', morphs into:

> my scent my taste my cunning away to
>
> lingual rich lingual the lingua franca of the ancients

lingo-accents[308]

That is, this scent/taste language not only becomes capable of somehow expressing or enveloping the conceptual and the emotive ('cunning'), but is also both universal (a *lingua franca*) and ancient. The *lingua franca* metaphor presents both the human and nonhuman variants of the animal as alike in kind despite their differences: as speakers who attempt to communicate although their native languages are different, and as subjects. It also at once suggests both mutual comprehension and a certain lack of it, since a *lingua franca* is never a first language. There is 'noise' in this particular machine. Then again, the wolverine's repeated reference in these passages to its own 'cunning', a common epithet we use in respect of certain animal (and human) behaviours, surely implies a dimension of animal 'self-awareness' and reason that must exist in and through the representative capacities of the scent/taste language. In some crucial way the wolverine figures in the poem as subject as well as object, with all the additional problems that this position entails.

If the wolverine, in Simms's poetry, has the ability to represent, then Simms is challenging Rilke's human/nonhuman distinction. If man is unable to access the unadulterated Open, Simms's wolverine must be equally unable to do so. This interpretation seems to be borne out in 'Carcajou', which simultaneously foregrounds both the wolverine and the human yearning for the – at once imagined and unimaginable – Open that is foreclosed by the ceaseless production of mediating representation. The wolverine's next wistful soliloquy, which simultaneously constitutes a critique of linguistic representation and is also something of a condemnation of the scientific approach and an endorsement of modernist poetry, runs:

ez easy as Pound pound it out

as with the life of words

we preserve only to destroy, transmute

or first denature, then presume *captive,* found

what is it we try to cultivate grasp at as it were before it was too late?

what is it we are after[309]

If representation debars access to the Open, according to Rilke, then – in Simms's philosophy, at least – it seems that the Open must be equally inaccessible to both the human

[308] Simms 'Carcajou' p. 44.
[309] Simms 'Carcajou' p. 45.

and the nonhuman. They are instead trapped in a self observing second-order cybernetics system.

5. Observation and objectivity

The common predicament of the lyric subject and the wolverine in 'Carcajou', each exiled from the Open and cast in the role of perpetual spectator rather than participant, is embodied in the simultaneous dynamic of observer and observed that each occupies in 'Carcajou.' The poem presents the human and the nonhuman in a relational mode of observation and representation that perhaps extends – or at any rate can be read using– Rilke's presentation of the human subject stuck in spectatorial alterity to the freedoms of the nonhuman. Simms's figuring of man and wolverine as observer and observed both mimics and critiques Western modes of scientific observation and representation, and the attempt at objectivity that underlies any resulting 'knowledge', which, he seems to suggest, compounds these problems.

For much of the late nineteenth and early 20th century, objective observation appeared desirable for scientific purposes because of its perceived association with respectability, authenticity and authority, and because it appears to provide a consistent basis for comparison. It also assists the communicability so vital to a collaborative discourse such as science. Yet this urge to pin down universal 'facts' free from 'bias', to persist in the pretension to a supposed view from nowhere, is problematic. As Daston and Galison remark in their history of objectivity, observation is intimately bound up with the self of the observer.[310] True scientific objectivity always proves illusory: firstly because it is impossible even to hypothesise without filtering data through the medium of one's own perspective, and secondly because the act of observation or measurement may itself physically affect the object of study (the 'observer effect'). In both senses, we are comprehensively enmeshed within the physical ecosystems and among the animals we attempt to study, as well as in our own systems of representation, and we affect the operation of these textual and ecological systems even in the always anthropocentric acts of observation and representation. Yet we seem condemned to a ceaseless attempt to represent the unrepresentable, and so in some way to *own* it, coupled, moreover, with that equally problematic attempt to pretend that we are not within the frame of our own observations. As the historian of science Robert Kohler comments, 'the observer's gaze is *selective* [my emphasis] and serves several purposes at

[310] Lorraine Daston and Peter Galison *Objectivity* (Cambridge, MA and London: Zone Books, 2007), p. 234.

once: visual pleasure and the desire to admire or possess striking forms, as well as precise science.'[311]

In 'Carcajou' Simms repeatedly reminds us that both science and poetry constitute our 'imagined scheme-of-things' and his poetry always acknowledges that *because* humanity is enmeshed within these representational systems and conceptual schema we are unable either to obtain any exterior perspective or to delineate the boundaries of our study in any non-arbitrary way. The traditional scientific pretence at objectivity masks not only these problems but also a pervasive set of value-judgments and assumptions and, in addition to these ethical questions, presents a reductionist, determinist and ultimately flawed approach to understanding complex natural systems. The insistence upon a specious conceptual separation from our nonhuman companions also ultimately downplays our environmental impact. Nonetheless, the Western need for 'objectivity' seems to have acquired the force of morality.[312]

The problem of objectivity is particularly relevant to the study of complex biological 'ecosystems' and their animal inhabitants – including wolverines and humans. As 'Carcajou' implicitly demonstrates by repeatedly setting up and then merging or destabilising binaries, wolverines and humans are not, in any meaningful ecological sense, separable. The complexity of these ecosystemic connections actually seems to be modelled in Simms's poetic form itself, in a set of textual and contextual complexities. It is noteworthy that Daston discusses the simultaneous movement of art away from verisimilitude as science tended towards objectivity.

Perhaps the modernist experimentation of Simms's poetry reflects the precepts of second-order cybernetics, which themselves anticipate emerging ideas of complexity theory that were only starting to become fashionable at the time he was writing.[313] Read in terms of the second-order cybernetics with which this chapter opened, 'Carcajou' very clearly offers a formal depiction of the simultaneous switching between observer and observed, and we are reminded that studying the system means studying the observer within the system. In his periodic direct address to the reader and his consistent use of the word 'we' which seems to

311 Robert Kohler *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* (Chicago, USA and London, UK: University of Chicago Press, 2002), p. 102.

312 As Daston and Galison point out in their history of objectivity, objectivity began as a system of policing others and came to be a system of self-restraint – p. 174.

313 Lorraine Daston 'Fear and Loathing of the Imagination in Science' *Daedalus* 134.4 (2005), pp. 16-30 at pp. 20 and 24.

incorporate the reader within the text, Simms acknowledges a yet further layer of observation – that is, we are within the poetic system that we are studying.

But Simms's poetry seems to take us further than this. In some ways he actually seems to be anticipating ideas drawn from complexity in his work. Not only do the formal poetic dimensions of 'Carcajou' remind us that the parts of a complex system (man or wolverine, for example) cannot usefully be studied in isolation or with 'objectivity', but the poem also seems to illustrate the fact that the emergent properties of ecosystems derive from multiple contingent and stochastic interactions occurring between the parts at all levels of organisation, as do the emergent properties of textual representation. That is, the operation of complex systems stems from the dynamic distribution of representation, information, and significance across the entirety of these systems, rather than being invested in conceptually separable individual parts. If we do attempt a study of the component parts, this must involve an awareness of how the parts are both temporarily anchored by their context and simultaneously themselves form the context for other parts (a fluidity that is demonstrated in Simms's poetry by, for example, both the use of collage and the creation of portmanteau neologisms in which words appear to have collided). The parallels here between how ecological systems, innovative poetry, language, cognition and 'knowledge' operate are clear.

In Simms's philosophy it is always evident that we cannot, in some respects, see the wood for the trees. Yet a committed study of complex ecological relationships – particularly when conducted through the equally complex medium of poetry – of necessity begins to engender an eco-ethical approach to the world. It is in the spirit of this gentler poetic and ethical 'science' and, perhaps, an acknowledgement of intersubjectivity that Simms offers us 'Carcajou', a work that challenges the supposed objectivity of orthodox science and yet couples subjective poetic observation with the rigour of science and a set of hybridised discourses drawn from disparate fields.[314] These differing forms of representation are themselves part of the complexity that makes up the world; there is no outside, in any meaningful sense, but this is not a problem.

Evidently, complexity itself is rather resistant to modelling and representation, by virtue of its very nature: a complex system is incompressible. Simms's attempt to grapple with the complexities of ecological systems results in a quality of textual 'roughness' and immediacy, a sense that he is taking rapid notes in the attempt to engage with the vastness of the

[314] There are parallels here with what the Language writer Joan Retallack has dubbed the '*poethical*'.'

connections that surround him, coupled with a sense that to some extent language is failing him. This is poetry as cognitive process. At the same time, his poetry is itself as incompressible as the complexity that structures it. A related result of Simms's experimental practices is that the poetry does not tend to engender a sense of a central linear progression, nor one of hierarchy. This serves to decentre the human. Whilst Simms's work is not in general as 'post-linear' or 'multi-linear' as a great deal of experimental poetry, its relationship with linearity is not entirely uncomplicated.[315] In Simms's philosophy, in accordance with his apparently innate understanding of complexity, we are invited to *decentre* anthropocentrism in both text and world and to refrain from privileging any particular factor, whether human or otherwise, more than any other. These ideas are played out formally within the non-hierarchical, non-linear developments of his poetry, a poetry that is explicitly one of 'observed relationship.'[316] According to Simms, it is through an ethical, interactive, and thoroughly subjective form of study (even solipsistic, in line with the criticism of second-order cybernetics with which this chapter opened) that we truly start to gain 'knowledge' of the complex natural world. In fact, it is through playfulness:

The bending greentwig pent-rafts rigs the log against the sky

why shouldn't I go on twisting

the steady-breathing of the sly

means mean is flinging the capacity for fun

we play then, you and I at last[317]

6. A reciprocal dynamic

It is possible to read 'Carcajou' as presenting an intersubjective field, a chiasmic linking/intertwining, between the three entities of poet, lyric subject, and wolverine. It is not clear that this reading helps us, however. As Morton remarks,

> 'some ecological writing aspires to the notion that the ecosystem makes available an idea of intersubjectivity, an entanglement of minds with other minds and perhaps nonmental or inanimate things. Reframing subject/object

315 Ian Davidson *Ideas of Space in Contemporary Poetry* (New York: Palgrave Macmillan, 2007), p. 138.

316 'A poetry of observed relationship' appears in 'The Crags at Crookleth Beacon', anthologised in Tarlo, Harriet *The Ground Aslant: An Anthology of Radical Landscape Poetry* (Exeter, UK: Shearsman Books, 2011), p. 22.

317 Simms 'Carcajou' p. 39.

> dualism in a 'better' way, as a dualism of subjectivity/intersubjectivity, is a 'new and improved' variant of the same dualism.'[318]

In any case, although Simms presents the lyric subject and Carcajou as being aware of the presence of the other within the physical and textual landscape, the *focus* of the gaze is different in each case. This suggests that any intersubjectivity must be illusory or inherently unstable: predator and prey, although both experiencing the hunt, have radically different viewpoints although they are related in opposition. To say that roles switch between observer and observed, and to say that we acknowledge the role of the observer within the system, is not to say that these entities play interchangeable parts. The Inuit to whom Simms refers in the third line of the poem ('In uit') use the wolverine's fur to trim clothing and also sell it; what to the wolverine is a skin becomes a commodity to the human (and a valuable one at that – because of its hydrophobic nature, the wolverine's fur is highly frost resistant). The value of observing the interrelationships and interdependence between human and animal to which Simms, in true ecological mode, draws attention, lies not in an imagined collectivity of experience with nature but also in the reminder of our separation, the difference of experience and, perhaps, an ethical responsibility to the world. As Greg Garrard, in discussing Berger's essay, remarks: 'when we look at animals, they return our gaze, and in that moment we are aware of both likeness and difference.'[319] Simms's notion of the nonhuman seems similarly nuanced.

In 'Carcajou' the enmeshing of 'self' with 'not-self' is not only offered as an idea that is a part of the external world – that human and animal co-exist in the landscape, interact in a mutually formative fashion, and experience some limited degree of intersubjectivity – but also as something that occurs internally: that is, the similarity of the individuals, the reciprocal acts of representation that follow encounter and observation, and the mutually 'animal' nature of these individuals in 'Carcajou' seem gradually to engender an *actual melding* of subjectivities, in an interrogation of borders that seems to extend our idea of trans-corporeality. No longer stable bounded individual entities, the bodies of the human and the wolverine are conceptualised as 'open', porous, shifting. Human and wolverine not only create one another in observation and representation, but in some respects they seem to merge. This is indicated not only directly and unambiguously by way of the subject matter and by the increasing degree of conflation of the poem's fragmented lyric subject with the

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318 Morton, *Ecology without Nature*, p. 106.

319 Greg Garrard *Ecocriticism: The New Critical Idiom* (London, UK, New York, USA, and Canada: Routledge, 2011), p. 139.

similarly fragmented wolverine (for example, ‘theres [sic] something animal in all of us’, ‘the poem for our own marriage!’, ‘we of the weasel family survive by this’, and ‘I’m wide and low and take things slow’), but also obliquely, through the persistent and multi-directional textual connections that are drawn between observer, landscape and wolverine through the imbricated formal patterning of self-reference and direct address:

> what is it we are after
>
> you, the survivor, know though you are modest
>
> I have some rest[320]

Another useful way of reading all of this, of course, might be in terms of Lynn Margulis’s idea of symbiosis; the merger of wolverine and human seems to suggest an idea of endosymbiotic integration.

Simms’s idea of a reciprocal relational dynamic between human and wolverine becomes visible in part because Simms’s observations are as much addressed to the wolverine as to his reader. He repeatedly apostrophises the eponymous Carcajou in a way that could be read metaphorically as an act of interpellation, calling the wolverine into being as subject rather than object. A reading of a one-way interpellation of the nonhuman by the human, although acknowledging its subjecthood, would nonetheless be a patronising conceptualisation of nature’s relationship with humanity: we would still be suggesting that nature is constructed by culture and ‘finds’ itself upon our terms. Simms himself seems to argue against an interpretation based on a unidirectional dynamic of creation: ‘I’m not making you’, he reminds Carcajou.[321] Instead, as we have seen, the ideas of reciprocity and complexity run throughout ‘Carcajou’, from the way the wolverine looks back at the poet/narrator and reader with ‘eyes bright-red-brown-as-Mars / star for further level looking-in’, to the way it is able directly to address both poet and reader.[322]

Carcajou is, we infer, in a poetic act of autopoiesis, making himself. This has parallels with how, according to Maturana and Varela, we observe autopoiesis. As Bob Mugerauer puts it, Maturana and Varela posit that we discern two domains in respect of the organism in its environment: its internal, invariant organisation, and the variable structure connecting it to its environment. As a result,

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320 Simms ‘Carcajou’ pp. 37, 39, 42 and 45.
321 Simms ‘Carcajou’ p. 43.
322 Simms ‘Carcajou’ p. 37.

> ‘the core reality of the organism lies in the paradoxical, reciprocal relationship of closed organisation and open structural coupling.’[323]

A living system must distinguish itself from its environment and the same time maintain its coupling by continuously open dynamic interactions with its surroundings. Its physical chemical constitution is in flux and exchange with its environment.[324] Human and wolverine are locked in a permanent reciprocal relational dynamic of creation that seems to exist both within and outside representation, and which not only reveals but actually creates the interchanges and interconnections between bodies and selves, as well as foregrounding the different levels of observer within the machine. There is a marked resonance here in Simms’s thinking with our contemporary understandings of ecosystems and interspecies relations as complex systems.

7. The Open and the open field

Perhaps paradoxically, the very form of the poem ‘Carcajou’ might itself be read as a metaphor for the shared animal/human yearning for the Open that is, according to Rilke, persistently foreclosed by representation and our consequent spectatorship. To put it another way, our longing for the unavailable Open is embedded or inscribed in the very form of the poem, in its visual and topological interrogation of its own physical borders, and what might lie beyond them. We can read Simms’s open field poetic form as a continuous and self-limiting attempt to investigate an imagined Open that lies beyond the poetic text. Of course, this reading rests on an innate tension: the topographical spread of the page itself, as the textual landscape, reflects the real landscape, but also ultimately replaces it. Simms not only engages in the representation of a landscape, but, as he is uneasily aware, at the furthest point, creates a simulacrum, which is the very thing that debars us from the Open and condemns us to our myopic spectatorial role.

To explore these ideas a little further, we need to consider how Simms’s poetics operates within an open field tradition that derives from the formative influence on his work of Charles Olson, in particular, together with Robert Duncan and William Carlos Williams. Harriet Tarlo’s work is helpful here as a starting point: in one of the very few critical treatments of Simms’s work, Tarlo describes the ‘space or place’ of the poetic ‘field’ as a symbol of permission for poets with a simultaneous interest in open form poetics and the

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323 Bob Mugerauer, ‘Maturana and Varela: From Autopoiesis to Systems Applications’, in Arnold, pp. 158-178 at p. 159.

324 Mugerauer, p. 160.

complex nexus of ideas around landscape and environment.[325] Tarlo describes the poetic field both as something "that is and is more than a trope or metaphor. It is a place, a space, a structure, a form, a philosophy, an ethics." Extending Tarlo's ideas, it seems to me that Simms's work operates within this tradition for a reason that is very pertinent to his interest in – and understanding of – the complexities of landscape and environment as well as philosophies that pertain to language and world.

As Tarlo points out, an open-form page is nonetheless a bounded form.[326] The 'poetic field' of 'Carcajou', for example, is a 'tentative container' for the complex poetic system that Simms has created, a provisionally bordered field of complexity – the complexity, that is, of both the text itself and of the underlying observed landscape. Simms's poetic field is simultaneously both an actual place and an abstract, even hypothetical, entity, a model set up for his and our exploration – that is, an ecosystem. 'Carcajou' is always bordered or bounded on the page by the space of the page margins, yet Simms encroaches into those spaces, or punctuates line endings in a way that suggests a travelling off, an openness, an engagement with the reciprocally contextualising material outside the field (whether that field is language or landscape or ecosystem). Simms's open poetic field is in fact always suggestive of a provisional move beyond the artificial containment of a field or an ecosystem and into the more global complexity – the unmediated Open – that surrounds it. That is, the artificial, arbitrary nature of the boundaries of the complex textual system of the poem is always acknowledged, in line with Simms's implicit understanding of the openness but operationally bounded form of complex ecosystems.

At the same time, therefore, in foregrounding an innate understanding of complexity theory and its focus on the porosity of borders and boundaries of all kinds, perhaps Simms is actually suggesting that the Open that lies beyond representation, the world around and outside the text, is not as unattainable as all that, either for the poem's lyric subject or for the wolverine. Indeed, the world around the text is part of the text, incorporated by reference, and the text is part of the complex system of the world. This radical suggestion, as embedded in poetic form itself, challenges Rilke's conception of the nonhuman on two counts: according to this interpretation of Simms's work, the Open cannot be used as the hinge of a binary that divides human from nonhuman, and furthermore the Open is not

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325 Harriet Tarlo 'Open Field: Reading Field as Place and Poetics' *Placing Poetry* Eds. Ian Davison and Zoe Skoulding (Amsterdam and New York: Rodopi, 2013), pp. 113-148 at p. 117.

326 Tarlo, Open Field', p.128.

(necessarily) inaccessible to the representing human/nonhuman animal. As Simms himself puts it, we must 'insist Rilke was wrong'.[327]

In conclusion, then, Simms's sense of natural complexity is formally embodied in the non-linear, non-hierarchical, dynamic and fragmentary style of his work, even as the substantive and formal complexity of the poetry is itself informed by Simms's scientific knowledge of ecosystemic complexity and synergy. In 'Carcajou' Simms offers an examination and a fusion of the roles of observer and observation, a sensitive acceptance of the inevitability of the observer effect, an affective and subjective recognition of a common nature, and a critique of some of the implications of Western scientific methods, that together demonstrate a daring attempt towards a more comprehensive understanding of the complex natural world. His poetry contributes both to our ability to relate empathetically to other animals and to our more rigorous understanding of complex ecological and biological systems. This arises from his inherent recognition of the imbrication of mankind and the natural world, an innate acceptance of the congruencies between the human and non-human, and an intelligent and dynamic focus on relational modes of being rather than on subject or object. The textual 'roughness' and sense of immediacy in his work, together with his use of open field poetics and collage, helps Simms to wrestle with what it might mean to *encounter* the nonhuman on an equal and ethical footing, and to nudge at the limits and gaps in ideas of experience, commonality, relationship, and representation.

As Simms knows, no form of 'knowledge' is above suspicion, and nor should it be. Our best approach is an integrative one that hybridises some aspects of these philosophies with modes of thinking drawn, however imperfectly, from discourses such as second-order cybernetics, complexity theory, secular philosophies, the sciences, non-Western spiritual systems, and poethics. It seems appropriate to give Simms himself the last word here, one last address to Carcajou that accepts our common evolutionary ancestry. It also seems to explore the possibilities of Carcajou's relationships with its landscape and coinhabitants over time, in a way that is arguably commensurate with the imaginative 'fast-forwarding' practices described by Kohler to reveal succession, the wolverine's 'momentum over millenia.'[328] As with Geraldine Monk's poem 'palimpsestus', touched upon in an earlier chapter, the space on the page is translated into both 'textual' and ecological time: into the physical time of the reader's reading but also into an imaginative depiction of succession:

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327 Simms, 'Carcajou', p. 38.
328 Simms, 'Carcajou', p. 40.

this is a wood you increase by coming-out-of-it –

out into the snow with a sawing motion of it –

bear-lope muskrat-ramble badger-trundle marten-amble

the evolution we are in

is secondary-skin[329]

[329] Simms ‘Carcajou’ p. 38.

CHAPTER 5

Thinking through connections in Lyn Hejinian's 'The Lake' and 'Sunflower'

'A complex system cannot be reduced to a collection of its basic constituents, not because the system is not constituted by them, but because too much of the relational information gets lost in the process.'

Paul Cilliers, *Complexity and Postmodernism*[330]

'The concept of autopoiesis is glaringly absent from the literature on systems ecology.'

Capra and Luisi, *The Systems View Of Life*[331]

1. Poetry on the edge of chaos

By the latter half of the 20th century, ecosystems were still studied as systems but a greater emphasis began to be placed upon the complexity of these systems, their contingency, and the largely unpredictable operation of feedback. To say that a system is 'complex' is not merely to say that it is complicated. If a system is 'complicated' it might involve vast numbers of interactions, but these would operate in a predictable fashion. Complex systems do not; their operation cannot be predicted from a study of their constituent parts, because many of their properties arise from interactions between parts at all levels of organisation. Moreover, many of these interactions are not predictable because they contain a high level of contingency and involve the operation of positive and negative feedback within the system itself. In other words, such a system would have emergent properties that derive in part from its overall organisation *as* a system, and cannot be studied by an assessment of the parts alone. Another way of describing emergent properties is that they arise out of more fundamental entities, and yet are 'novel' or 'irreducible' with respect to them. There are clear links with language here.

In addition to self production and emergence, there are a number of other key features of complex adaptive systems such as living systems.[332] These include the incorporation of large

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330 Paul Cilliers *Complexity and Postmodernism: Understanding Complex Systems* (London and New York: Routledge, 1998). p.10.

331 Fritjof Capra and Pierre Luigi Luisi *The Systems View of Life: A Unifying Vision* (Cambridge: Cambridge University Press, 2014), p. 347.

332 Various theorists have listed some of the common features of complexity, and for greater detail I would refer the reader to one or more fuller accounts, such as those set out in Cilliers at pp.3-4 or in Cliff Hooker, *Philosophy of Complex Systems*, (UK: Elsevier, 2011) at pp.14-15, which is particularly useful,

numbers of individual elements, the relationships between which are at least as important as the elements themselves. We might characterise these interactions as non-linear, dynamic relationships. For this reason, it is difficult to model or represent complex systems in any useful fashion – they cannot be compressed, and thus any model must be just as complex as its real counterpart, obviating its usefulness. This parallels the impossibility of poetic paraphrase.

One aspect of complexity that has been explored in poetry, as we have seen, is that of autopoiesis. Self organisation in complexity terms, as distinct from its original version, means the spontaneous emergence of new order in complex systems governed by nonlinear dynamics. Yet autopoiesis is not broadly accepted in mainstream ecology, and does not occur in many key texts. Until more is known about how ecological systems operate it is difficult to say whether or not it applies at the level of the ecosystem. In addition, complex adaptive systems tend to contain subsystems, which are in constant flux. One or more such fluctuations may operate so powerfully, through positive feedback, as to shatter the pre-existing organisation; these are systems on the edge of chaos. It is impossible to determine in advance which direction change will take and whether the system will disintegrate into chaos or find another level of order; it has been suggested that climate change may operate thus catastrophically.[333] Other key features of complex systems are that they are 'open' systems that interact with their environment, but they are also bounded systems. Finally, complex systems exhibit 'downward' causation, and yet each element in the system operates as a result of relatively local interactions.[334] This means that in order to try to understand complexity we need to move beyond traditional assumptions of centralised control or command – which, as we have seen, are implicit in earlier ideas of the ecosystem. Complex systems, although considered to be self-organising, do not feature any central control mechanisms, nor does complexity imply the existence of any organising agency, consciousness or subjectivity.

There are a number of ways we could legitimately approach an analysis of Lyn Hejinian's poetry from the point of view of complexity theory. However, the themes of complexity are extensive, and given spatial constraints I have had to select two principal themes: borders

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but too long to summarise here. Clearly, because of the operation of contingency and local interaction, all complex systems are different – even those which might be thought of as being within the same category – and will exhibit different features.

333 Prigogine and Stengers called this a 'singular moment' or a 'bifurcation point.' Prigogine and Stengers, p.160.

334 See Mitchel Resnick, *Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds*, (Cambridge, MA; London, England: The MIT Press, 1997)., Chapter 4 in particular.

and boundaries, and connections and relations. Two texts in particular that I will look at are Hejinian's 'The Lake' and 'Sunflower', both of which were collaboratively produced with the artist Emilie Clark and the ecopoet Jack Collom respectively.[335] The texts of these poems are set out in Appendices 1 and 2. Unfortunately, it is not possible to reproduce the artwork from 'The Lake', which is very much an integral part of the work. I have already introduced 'The Lake' in an earlier section. 'Sunflower' is taken from the collection *Situations, Sings* (2008) and came into being through an exchange of free-verse lines through the post between Hejinian and the late Collom.[336] At first sight 'Sunflower' is less obviously disjunctive than 'The Lake', featuring as it does entire sentences and phrases that operate as discrete units, and again seeming to transmit collections of sensory materials alongside a less oblique commentary on the nature of conscious experience and thought.

Before I turn to the poetry I will briefly set Hejinian in context, as a founding figure of the Language writing movement of the 1970s, and an influential force in the world of experimental and avant-garde poetics. Hejinian developed a poetics, as principally outlined in *The Language of Inquiry*, that was of pivotal importance for the development of Language writing.[337] Whilst it is perhaps dangerous retrospectively to ascribe too many common aims or methods to the Language writers, who were after all a diverse and geographically widespread group, it is reasonable to say that many of these writers sought to foreground the materiality and importance of their medium, language itself, over traditional ideas of representation or narrative as an approach to the wider world, and over any exploration of subjectivity; and as part of this that they wished to challenge received relations between the poet, his or her reader, and the text.[338] In so doing, many Language writers sought to destabilise words as signifiers, and to reveal the implicit power relations they contained: as Hejinian remarks, 'We had at our disposal the medium that was perfectly suited for investigating the overt and covert, buried and transcendent, material and metaphysical logics which *are* language and which so powerfully influence human thought

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335 Jack Collom and Lyn Hejinian, 'Sunflower' in *Situations, Sings* (USA: Adventures in Poetry, 2008), pp. 65-81.

336 , Jack Collom passed away on 2 July 2017. The 'Postface' to *Situations, Sings* explains that Hejinian and Collom met in 1992 at the Naropa Summer Writing Program and subsequently began composing collaboratively by means of 'snail-mail', in part to preserve the unhurried pace of the more traditional, contemplative epistolary space. See *Situations, Sings*, p. 191.

337 *Poetry Foundation*, accessed online at <http://www.poetryfoundation.org/bio/lyn-hejinian> on 16 December 2013.

338 Hejinian warns in the essay 'Barbarism' that 'I don't believe that any adequate history of the movement can be written by a single one of its members' (*The Language of Inquiry* at p. 320), although she does go on to list some of the premises of the movement (p. 323). Ron Silliman also tried to summarise the aims of the group in the introduction to the anthology *In the American Tree*. An extensive discussion of Language writing is beyond the scope of this thesis.

and experience.'[339] A number of these poets and writers also saw writing as a community-based activity, hence the number of collaborative projects to which the movement gave rise – including Hejinian's work with Clark and Collom that is discussed in this chapter as well as other collaborations that are not, such as with the late Russian Language poet Arkadii Dragomoshchenko. The implications for any interpretation based on the idea of a complex poetic or textual system (of writing figured as a community-based activity) are evident, adding yet another set of actor/agent feedback relations into the mix. The notion of writing as a community-based activity also feeds into the emphasis on the role of the reader and the rejection of closure, as further discussed below.

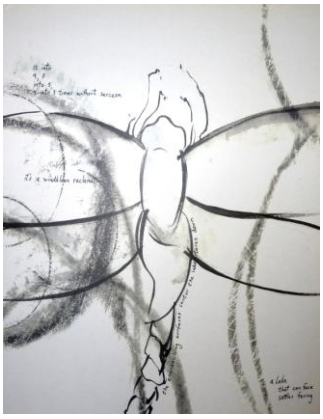
2. The rejection of closure

In this I chapter will explore how Hejinian uses 'open' texts, in tandem with ideas drawn from the work of the American pragmatist philosopher William James derived by way of Hejinian's Steinian heritage, to stage both formally and thematically in poetry, and so to reveal, the complex ecologies that we inhabit – and just how we understand them. Although, unsurprisingly for poetry of this sort, 'The Lake' features no apparent lyric subject to whom the reader may attach the sense data indicated in the poem, 'The Lake' nonetheless seems to render a phenomenological description of an encounter with Lake Wentworth, but this encounter is maximally distributed throughout the text, as are the constituent features of the ecosystem of 'The Lake'. Perhaps oddly for a poem about a body of water, there is just one reference to water: 'the water is the spider.' Thematically, almost all of the words do seem to relate to ecologies, landscapes, and how we experience them, reminding us of biological forms, a gentle rise, of holistic systems, the pleasure we might feel wandering by a lakeside, in a kind of Romantic solipsism. Animal inhabitants seem to swim through the textual landscape of 'The Lake', as image (dragonfly and frog) and word (turtles, chars, or arachnids), but how they relate to one another or to any observer (either inside or outside the text) is unclear. What seem to be the material constituent parts of the lake's biology are often counter-intuitively conjoined, or presented alongside abstractions and challenging speculations, such as 'How does one think nonetheless emotions?' There is no obvious signposting as to what the reader should make of the work, although, as we know from Hejinian herself, the poem can be read as an 'ecosystem', both actual and textual, with a focus on 'interrelationships, simultaneities, and the extents of layers.' A second general observation we can make about 'The Lake' is the way it exemplifies Hejinian's radical

339 Hejinian, *The Language of Inquiry*, p.324.

hermeneutic openness. Expected connections are elided or at best ambiguous, and the linearity of the poem is sometimes doubtful.

This difficult sort of connectiveness has been characterised as 'attenuated hypotaxis': namely, the use of 'tenuously interconnected' clauses and phrases possessing some relation of subordination to another element but with the connections blurred.[340] We can connect the notion of attenuated hypotaxis with Hejinian's 'rejection of closure', and similarly with the 'New Sentence' of the Language writers, characterised by Ron Silliman as a sentence that controls or minimizes the 'syllogistic' meaning expected from prose by altering the structure, length and placement of the sentence to increase its ambiguity or polysemy.[341] The elisions that occur where we would expect a conjunction are critical to understanding Hejinian's poetics as a physical site of meaning making. Because the semantic connections are not unambiguously indicated for us, all sorts of other factors to do with the dimension of the shape or sound of words, their placing on the page, etymological resonances, and so forth, offer themselves for our attention. The reader stitches the text into something with a semantic unity. That is, the unity is not necessarily present in the text before the reader interacts with it.[342] As Hejinian remarks, the 'open text' 'often emphasizes or foregrounds process, either the process of the original composition or of subsequent compositions by readers': we are within a complex dynamical system.[343]



Hejinian and Clark, *The Lake*[344]

340 Brian Reed, writing on Hart Crane: Brian Reed *After His Lights* Modern and Contemporary Poetics series (USA: University of Alabama Press, 2006), p. 118.

341 See the collection of critical essays in Silliman, Ron *The New Sentence* (New York: Roof Books, 1987). For a thorough exploration of Hejinian's use of the New Sentence, see Peter Middleton, 'Cutting and Pasting: Language Writing and Molecular Biology', in *Science in Modern Poetry*, ed. by John Holmes (Liverpool, UK: Liverpool University Press, 2012).

342 This distinguishes it from the organicism of previous criticism.

343 Hejinian, *The Language of Inquiry*, p. 43.

344 Hejinian and Clark, 'The Lake', tenth stanza/page.

In the retrospective preface to her influential essay 'The Rejection of Closure' (1983), Hejinian writes that:

> 'I can only begin *a posteriori*, by perceiving the world as vast and overwhelming; each moment stands under an enormous vertical and horizontal pressure of information, potent with ambiguity, meaning-full, unfixed, and certainly incomplete. What saves this from becoming a vast undifferentiated mass of data and situation is one's ability to make distinctions. The open text is one which both acknowledges the vastness of the world and is formally differentiating. It is form that provides an opening.'[345]

From an ecological perspective, Hejinian's sense of the vast complexity of the surrounding world is particularly resonant. It is not viable to model the self-organisation and multiple emergences that operate within the biosphere comprehensively. But from the poet's perspective, that planetary vastness and complexity is equalled by the vastness and complexity of language, and language, when it is turned into poetry, can foreground differentiations and draw out patterns. It is form, Hejinian argues, that turns 'vastness into plenitude', that makes the primary chaos articulate without depriving it of its 'capacious vitality', its 'generative power.'[346] Hejinian's writing here seems to be informed by the new scientific notions of complexity that were beginning to circulate. We can speculate that this may well have informed her poetics.

One of the key ways in which Hejinian's work is relevant to the complexity of ecological systems is though her interrogation of notions of borders and boundaries and of whole and part, which, as we have seen, are problematic questions in the study of ecosystems. How do we define the geographical extent of study, or the level of organisation? Furthermore, ecosystems do not exist as static snapshots; they are dynamic systems whose processes unfold over time. An early example of a scientist's answer to some of these problems of delineation is that of the ecologist Raymond Lindeman, who in 1941 produced a famous study of the trophic dynamics of Cedar Bog Lake, Minnesota for his doctoral project, which is popularly considered to be ground-breaking in the development of ecosystem ecology.[347] In order to define the spatial dimensions of his ecosystem Lindeman used the lake's watershed; this convenient marker was also employed by a number of subsequent ecologists,

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345 Hejinian, *The Language of Inquiry*, p. 41.

346 Ibid, p. 47.

347 See Raymond Lindeman, 'The developmental history of Cedar Creek Bog, Minnesota', *American Midland Naturalist* 25, 1941, pp. 101-112, and Raymond Lindeman 'Ecological dynamics in a senescent lake' PhD thesis, 1941 University of Minnesota, Minneapolis.

resulting in a further series of limnological (freshwater ecology) studies.[348] Lindeman also sought to define the level of organisation at which the 'ecosystem' can be found. He characterised the ecosystem as the fundamental unit of trophic dynamics, in which organisms could be categorised according to their level within the food chain.[349]

It is partly because of the prevalence of lake ecosystems in ecology that I have selected Hejinian and Clark's 'The Lake' as my first example. The poem seems to exemplify how ecology works as a science, in the sense that it is necessary to contain the grounds of a study of the natural world within a form (an ecosystem or other model) in order to study it. The forms that science bring to bear on ecosystems, such as the essentially arbitrary dimensions of the limnological studies, similarly allow us to make sense of the world. Hejinian performs the same exercise in presenting the poem 'The Lake' as an ecosystem, again making sense of vastness through form – that is, both the vastness of the textual and the biological landscapes.

In a general sense, we can note that Hejinian repeatedly juxtaposes ideas of part and whole, and centre and periphery, which are key to popular notions of ecosystems, to limnological studies, and to complex systems theory (for example, on the same page – 'the site is part ... /increment'; 'partially' on the previous page; 'the whole wanders'; 'the loose parts known as passions for connections', etc.). She is also concerned with what might – or might not – be shared, overlapping, or separate. Because of the open relations between these semantic 'units', it is entirely possible to read in a questioning or interrogatory tone here.

The first line ('Forms rise at pleasures the whole wanders') contains what initially appear to be three nouns ('forms', 'pleasures' and 'whole'), of which two are in the plural and one in the singular; but some of these could be construed as verbs (to form, to pleasure) and some of those we tend to read as verbs ('rise' and 'wanders') could in fact be operating as nouns. All of these versions are simultaneously viable. There may also be an aural pun on 'whole', in the sense that the lake is in a depression in the landscape. Indeed, the idea of a 'whole' that 'wanders' seems apposite, for a whole is a particularly flimsy concept when it comes to systems and ecosystems like that of 'The Lake', an abstract construct that might well 'wander', or – like the clouds in the following line – 'never come to what' it 'forms.' But beyond these vague suggestions, how we might best read this line is problematic; there is

348 Golley, pp. 4, 39, etc.

349 Golley, p. 55. According to Stephen Alfred Forbes, the study of aquatic systems derives from the idea of a lake as a microcosm, which is suggestive of a further layering. See Golley, p. 36.

only the word ‘at’ that seems to hint at a relationship between the words, a point to which I will return.

It seems reasonable to interpret the words in the seventh page/stanza beginning ‘an overlapping’ as a questioning of the porosity of borders of all kinds. The lake, critically, ‘can be seen’ as a ‘strong inclination’ (hill or dip, or another rise? Or something we would like?) that is ‘suspended’, a ‘barrier’ or a ‘sunken measure.’ On one level, this seems to offer ideas of the lake’s spatial form and geography as formally inscribed in the open text, but, because of the ambiguous connections between these words and phrases in the line endings, the extended caesurae and interstices, it could equally well be interpreted as a critique of the notion of complete systems, of ‘ecosystems’ as wholes, with ecotones and boundary zones.

Invoking notions of a ‘barrier’, ‘measure’ or ‘shape’ may also indicate a questioning of the adequacies of language; writing on *Tender Buttons*, Hejinian remarks that Stein’s recurring use of the motif of containment ‘is one that opens questions regarding words’ and sentences’ ability to “hold” meaning,’ which invokes a whole new set of problematic relations between ‘words’ and ‘meanings’ and ‘things’:

> ‘Stein is probing the fraught relationship between the semantics of perception and the syntax of the language in which it is expressed and described — or in which, perhaps, it actually takes place. [...] Variations on the motif [of containment] recur, and they refer in part to Stein’s concerns about the means and adequacy of writing— of capturing things in words.’ [350]

To return to Lakoff and Johnson, who were mentioned in the introduction, it is worth pointing out that they offer some thoughts about the nature of embodied mind in their studies of metaphor. They point out that the fact that we think about notions of inside and outside with regard to a bordered container springs from our embodiment. Lakoff and Johnson speculate that we project mental images of containers, in view of our embodied experience, onto abstract categories, and further that we use bodily experience of containment to reason about inside/outside.[351] This may explain why Hejinian invokes the notion of words as ‘container’ items – but porous, untrustworthy containers without a one to one correlation between sign and signified – in her discussion of Stein.

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350 Hejinian, *The Language of Inquiry*, pp. 102-103.

351 Lakoff and Johnson *Philosophy in the Flesh* (New York: Basic Books, 1999), pp. 34-35.

We can connect Hejinian's thoughts on Stein, as well as Lakoff and Johnson's work on those metaphors that spring from embodied mind and boundary, with Maturana and Varela's autopoiesis. Autopoiesis contains a number of paradoxes as an idea. For example, as applied to a cell, numerous chemical processes occur but the overall structure remains the same: it represents both constancy and change. Secondly life is a globalised property within that cell: there is no point and no particular chemical process at which life is localised. This is the same with complex organisms – life is an emergent property, present only when the parts are assembled. The cell is operationally closed in the sense that it needs no further information from outside to maintain itself, but it does need matter and energy, so it is thermodynamically open.

Maturana and Varela also introduced the notion of 'structural coupling' to their theory – that is, a living system relates to its environment structurally, through recurrent interactions, each of which triggers structural changes in the system and in the environment. Structural coupling is non-predictable at least in terms of the living part of the organism/environment complex, because the environment can trigger changes in the living system but not determine them, and it results in adaptation (and hence in evolution): the environment and the living organism in effect co-evolve. [352]

In parallel statements in her poetry and prose, Hejinian seems to think through some of these ideas. Maturana and Varela's systems, we recall, are both open and closed – closed in the sense that they are definable and organisationally self-sufficient, but open to energy exchange and feedback with the wider environment.[353] The idea of being simultaneously open and closed, in order to allow cognition (which was the purpose of Maturana and Varela's original explanatory model), is a difficult and paradoxical one that Hejinian negotiates both in her poetry, in a formal sense in the text of 'The Lake', and in her critical writing as well:

> 'The writer experiences a conflict between a desire to satisfy a demand for boundedness, for containment and coherence, and a simultaneous desire for free, unhampered access to the world prompting a correspondingly open response to it. Curiously, the term inclusivity is applicable to both, though the connotative

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352 We are reminded here of Gaia and life creating the atmosphere (its environment). Because the environment triggers a change in the structure of the system, its future response will be altered because the organism responds to disturbances according to its structure and that structure has changed: this is characterised by systems and social theorists as learning.

353 Varela and Maturana, 'Autopoiesis: the Organization', pp. 192-193.

> emphasis is different for each. The impulse to boundedness demands circumscription and that in turn requires that a distinction be made between inside and outside [...].'[354]

Here, Hejinian is using the metaphor in the way that Lakoff and Johnson describe it, and in effect articulating an ambivalent wish to somehow slip the boundaries of the embodied mind. In the passage from which I have quoted she is actually talking about what is relevant and not relevant. We can read this in terms of the environment being presented as a structurally coupled and co-evolving formation with the poet and also with the poem, in a way that recalls the open form/bounded form page boundaries of Colin Simms's work. This is an idea Hejinian also explored in her collection 'The Cell'.[355] As Maturana and Varela's model makes explicit, the boundary is the site of cognition: it is here, at the relational locus, that thinking happens. This is formally exemplified within Hejinian's poetry, and also something that happens at the edges and interstices of the poetic system, between reader, text, and world.

In one sense all this does is to remind us that language exists in context. As Saussure pointed out, any linguistic sign is determined only by its relation to other signs; it can only exist in context. But Saussure's work only looks at text determined by its context within a structure of signs; Hejinian's notion, clearly, comes from a later position, one that accepts the diachronic nature of language. Because of her position in chronological terms, and aware of contemporaneous science and literary theory, she is by virtue of her moment in time a systemic thinker. Complexity theory reminds us that the organism and the environment are context for each other and co-evolving simultaneously; that is, they bring each other into being and they are both simultaneously in context and also are context. We could borrow Timothy Morton's useful phrase here, that 'text dismantles distinctions between a 'within' and a 'without.''[356]

So language exists in context, text exists in intertextuality, the complex organism exists in its environment, and all of them are also structurally coupled with their environment; that is, they coevolve. We do not attain the same sense from the poem that the lake and the surrounding landscape coevolve: 'The Lake', as it exists on the page in a formal sense, has no surrounding margins; it simply exists within the outside world of the text. This parallels the distinction between ecosystems and cells when we think of autopoiesis; adjacent

354 Hejinian, 'The Rejection of Closure', pp. 41–42.
355 Hejinian, *The Cell* (California, USA: Sun & Moon Press, 1992).
356 Morton, 'Ecology as Text', p. 2.

ecosystems, unlike cells, share a single boundary (ecotone) which may be narrower or wider at different places. Could it be that Hejinian is drawing our attention to the dangerous leap in applying ideas of autopoiesis to ecosystems, which is on a level with the Gaia theory's confusion of selection and/or consciousness? Certainly, the only sense of movement with the lake's boundary is that we are told of a 'windblown reclamation', which is not at all the same as a co-evolution.

3. The line and the sentence

Language, in Hejinian's thinking, is like the wave/particle of quantum mechanics; that is, it exists in bounded or contained units, albeit unstable ones, at the same time as it flows back-and-forth with its context. This is yet another way that Hejinian problematises part and whole relations. Here, we need to bring Hejinian's fascination with the work William James into play. A reading of *The Language of Enquiry* reveals that Hejinian's understanding of James was significantly processed by way of Gertrude Stein, who worked with James on his studies of consciousness, being 'his most brilliant woman student'. It is Stein, Hejinian tells us, 'who extended James's philosophy into literary practice.'[357]

Throughout her collection of essays, and often in her discussions of Stein, Hejinian returns to the nature of lines and sentences, and the connections or transitions within and between them. The sentence often figures as expressive of a 'segment' or whole unit of thought, and the line as a measure of our perception of it:

> "If the sentence represents the entirety of a perception, a complete thought, then the line might be taken to represent the shape or scale or measure of our consciousness of it. A perception might come at one in segments, and the line represents such a segment, a unit of consciousness. Thus each line is an aspect of an idea, observation, or feeling. When one sentence ends and another begins on a single line, then the connection between the two is part of the plane of consciousness." [358]

Here we seem to return to a model of the phenomenological experience of 'The Lake', with thoughts and sensations, and the consciousness of thought, formally 'enacted' in the structure of the writing, in a way that reminds us both that the lake cannot exist for us outside our representations, and that we are implicated within the ecosystems that we experience. Yet there is more to Hejinian's syntax and grammar than this. There may also be

[357] Hejinian, *The Language of Inquiry*, pp. 143-4.
[358] Hejinian, *The Language of Inquiry*, p. 61.

a lingering influence of the 'new sentence' here, although by the time of 'The Lake' and 'Sunflower' Hejinian had turned away from its extensive use in her work. By 1999 she had come to the conclusion that a sentence – even, presumably a new one – has more stability than a line (which in her poetics, we infer, is not necessarily a good thing). Conversely, 'a poem based on the line bears in it a high degree of semantic mutability.'[359]

However, it is a different matter when it comes to links *between* lines or *between* sentences: there are, according to Hejinian, greater conceptual gaps between sentences than between lines, gaps that a reader might have to fill, than within lines. 'Both lines and sentences make a demand for other lines or sentences, linkages, but they do so in different ways and according to different syntactic and logical operations. Sentences may incorporate articulation of this kind within themselves, whereas principal articulation occurs between lines rather than inside them. [...] the conceptual space between sentences is greater than that between lines, so that the effort to achieve linkage between sentences may have to be greater.'[360]

In 'The Lake' it is not clear whether the poetry is operating at the level of the line or the sentence or both, nor what this means for its poetry 'as an art of linkages.'[361] One can identify units among its lines that seem to operate as sentences ('an overlapping/ differs from a shared / aftermath'), but because of the placing of the lines and lack of punctuation it is possible to read an alternative 'sentence' ('from a shared/ aftermath / the site is part/ increment'). That small word 'from' – perhaps predictably, given what we know of Hejinian's thinking – is working hard. And the conceptual gaps might be greater between the lines than the sentences, but the physical gaps on the page seem to be greater between those units that seem to operate as more isolated lines than between those that seem to coagulate into constellations of putative 'sentences.' Moreover, there is a sense of disorientation – even vertigo – in these gaps too, because although many of 'The Lake's' lines are orientated horizontally, a small number of them travel vertically and diagonally, and some follow curves. In keeping with the principle of openness, there is no obviously 'correct' order in which to read many of the lines and the 'semantic mutability' of this formal arrangement is clearly deliberate.

By contrast, in 'Sunflower' the work operates in complete and identifiable sentences, placed horizontally, which begin with clear internal linkages that seem to fade away ('At night in

359 See Hejinian, *The Language of Inquiry*, at p. 134, and also at p. 132.
360 Hejinian, *The Language of Inquiry*, p.132.
361 Hejinian, *The Language of Inquiry*, p. 13.

fall the sunflowers/ Are filtered through sounds like "Husserl" and arrive a little bluer/ Than the sky, though "pure consciousness" encountering "the appearance of things" may cloud/ The sunflowers, uns*lf worse, into "ur-owl-ness (f)/ (The word itself fouls wrens) and the iron shelters for the border guards bound by the strands of / rain'). Here, materials are collaged from other sources (indicated in quotes), invoking a new set of connections and relations, this time intertextually, as well as transcribing the poetic dialogue between Hejinian and Collom. The connections between ideas within the sentence become increasingly unstable, so that eventually some links are derived only from the letters of a word (the letters of sunflowers translate into whole new meanings when they become 'uns*lf worse', or morph from that into '"ur-owl-ness (f).' Yet there is a suggestion that language itself, so arranged, can legitimately make these links and connections between sunflowers, an 'unself', and 'ur-owls' ('ur' being a prefix denoting 'primitive, original, earliest'), each of which are also connected in ecosystem and episteme. This seems to embody a whole set of problems surrounding the designation of part and whole and their relations.

There is a wider point to be made here about context-dependence as well, in that Hejinian's work links with phenomenological notions of being-in-the-world, as well as with the phenomenology of William James and his doctrine of pure experience. The investigation of how sense data and thought are processed in 'The Lake' and 'Sunflower' is in line with William James's investigation of what he famously termed the 'stream of consciousness', an idea Hejinian returns in her essays in *The Language of Inquiry*. Hejinian points out that consciousness is in fact often experienced as discontinuous, sometimes radically abruptly and disconcertingly so, rather than as a 'stream.'[362] James himself also recognised this discontinuity in an extended metaphor in the *Principles of Psychology* (1890):

> As we take . . . a general view of the wonderful stream of our consciousness, what strikes us first is [the] different pace of its parts. Like a bird's life, it seems to be made of an alteration of flights and perchings. The rhythm of language expresses this, where every thought is expressed in a sentence, and every sentence closed by a period. The resting-places are usually occupied by sensorial imaginations of some sort, whose peculiarity is that they can be held before the mind for an indefinite time, and contemplated without changing; the places of flight

362 Hejinian, *The Language of Inquiry*, p.103 and p.77.

> are filled with thoughts of relations, static or dynamic, that for the most part obtain between the matters contemplated in the periods of comparative rest. . . .
>
> *Let us call the resting-places the 'substantive parts,' and the places of flight the 'transitive parts,' of the stream of thought.*[363]

The stream of consciousness, it seems, features both discrete substantive objects and transitive, continuous flux. Crucially, these transitive parts, in James's philosophy, are filled with experiences and thoughts of the relations between things. In a later essay, collected in *Essays in Radical Empiricism* (1912) James emphasised that 'The immediately experienced conjunctive relations are as real as anything else.[364] Here is James again, in *Principles of Psychology*, on the primacy of relations:

> 'There is not a conjunction or a preposition, and hardly an adverbial phrase, syntactic form, or inflection of voice, in human speech, that does not express some shading or other of relation which we at some moment actually feel to exist between the larger objects of our thought. If we speak objectively, it is the real relations that appear revealed; if we speak subjectively, it is the stream of consciousness that matches each of them by an inward coloring of its own. . . . We ought to say a feeling of ***and***, a feeling of ***if***, a feeling of ***but***, and a feeling of ***by***, quite as readily as we say a feeling of ***blue*** or a feeling of ***cold***. '[365]

In a somewhat similar passage, writing of Stein's challenge to the primacy of the noun, Hejinian writes that 'We must acknowledge our sensation of ***of***, ***if***, ***the***, and ***some*** as well as tree, smoke, shed, and road.'[366] As Hejinian points out, it is this focus on the importance of 'relations' that allows James to call his empiricism 'radical.'[367] In James's formulation,

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363 William James *Principles of Psychology (1890)* (Global Grey e-Books, 2014), p. 138.

364 William James *Essays in Radical Empiricism* (New York: Longman Green & Co., 1912), pp. 93. Subsequently, James went on to anticipate later theories of language and philosophy and the problem of access to the 'real' in *Some Problems of Philosophy*, published posthumously in 1916, in which he described how the 'perceptual flux' (that we experience as 'percepts') is processed by way of 'concepts', through a set of conceptual schema that are sometimes incommensurable but nonetheless concurrently valid, occasionally regrettable but always necessary. One of the more accessible passages of 'The Lake' ('A particular thinking on a lake/in passing as a lake/ is held and then a separate thought /of a lake') appears to be musing on that theme.

365 James, *Principles of Psychology*, p. 135.

366 Hejinian *The Language of Inquiry*, p. 93. Stein dismissed nouns as the least interesting parts of speech.

367 Hejinian *The Language of Inquiry*, p. 136.

> ‘To be radical, an empiricism must neither admit into its constructions any element that is not directly experienced, nor exclude from them any element that is directly experienced. For such a philosophy, the relations that connect experiences must themselves be experienced relations, and any kind of relation experienced must be accounted as ‘real’ as anything else in the system.’[368]

Clearly, a preoccupation with relations is something that Hejinian shares: in her essays she reminds us repeatedly of the importance of exploring relations – in *The Language of Inquiry* there are more than ten (often extensive) passages that deal with this subject.[369] So what is the net effect of all of this? Firstly, the poetry helps us to think through what types of relationships might occur, whether in language, conceptual scheme, or ecosystem. Hejinian is not so interested in the ‘metaphysical flimsiness’ of purely conjunctive relations, of things co-existing in proximity.[370] She is expressly interested in the transitions between things, and between things and us. These relations may be causal (taking the form of feedback), dialogic, reciprocal, transformational; they may be relations of conjunction or contiguity or of likeness/ analogy (which forms a cornerstone of our ability to reason). The connections and relations the poetry showcases helps us to discern textual and ecological patterns and order. Secondly, a focus on relations also has the effect of defamiliarisation: in Shlovsky’s formulation, it is the newness of art that restores to man his sensation of the world and it does this through imparting the sensation of things as they are perceived and not as they are known. Part of this is the experience **of** relations themselves.[371] Perloff neatly summarises this as follows:

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368 William James, *Essays in Radical Empiricism* (New York: Longman Green & Co., 1912), p. 22.

369 Hejinian *The Language of Inquiry*. See for example pp. 2, 8, 61, 93, 100, 102-3, 131, 132, 136, and discussions in pp. 148-9 on how metonymic relations operate; also pp. 166, 193, 313 etc.

370 ‘Merely to be ‘with’ one another in a universe of discourse is the most external relation that terms can have, and seems to involve nothing whatever as to farther consequences.’ Hejinian, *The Language of Inquiry*, p. 136, quoting James’s *Essays in Radical Empiricism*.

371 Shlovsky famously developed the concept of defamiliarisation in literature, explained in ‘Art as Technique’, by which the over-familiar can be revitalised: ‘The purpose of art is to impart the sensation of things as they are perceived and not as they are known. The technique of art is to make objects ‘unfamiliar’, to make forms difficult, to increase the difficulty and length of perception because the process of perception is an aesthetic end in itself and must be prolonged. *Art is a way of experiencing the artfulness of an object; the object is not important.*’ Viktor Shlovsky, 'Art as Technique', in *Literary Theory: An Anthology,* ed. by Julie Rivkin and Michael Ryan (USA, UK: Blackwell Publishing, 2004), p.16.

> '*Ostranenie*, as Hejinian remarks in a recent essay on translation, posits *relatedness* as the primary quality of poetic discourse. Relatedness can be imagistic or syntactic'.[372]

Turning again to the 'The Lake', it becomes apparent that the reason for its 'difficulty' principally lies in the ambiguous and multiplicitous nature of the relations it seeks to trace and foreground – that is, relations between words (as unstable 'units' that might seek to represent 'meaning') whether explicit (conjunctions, punctuation, prepositions, metonyms, metaphors), or implicit/ existing in potential (enjambment, parataxis, etc.) between the material (visual, aural, rhythmic) characteristics of words, between words and images, words and contexts, etymologies, sentences, lines, poets, intertextuality, poets and readers, and so on. This poetry makes hay with the connotative potential of language and the conceptual cross-domain hybridisations described by cognitive linguistics. It also takes a complicated approach to the paradoxes of openness and boundedness that I also touched on in the chapter on Colin Simms.

If this poetry is the site of meaning making, especially in the conjunctive sites of Hejinian's attenuated hypotaxis, what it really draws attention to is the pattern forming abilities of the reader. The work is multiply interconnected in our eyes because we cannot help but see that that way; our eyes refuse the existence of the syllogistic gap. Our instinct is to look for some sort of narrative or coherence. In resisting this drive, the text not only foregrounds its own materiality, but our urge to totalise. In fact by placing us in this position what the text does do is to warn as to be careful in the ways that we seek always to 'read' ecosystems, to attach to them the types of narratives and ideologies that we have seen throughout this thesis.

4. Borders and boundaries

Likewise, in 'The Lake' Hejinian uses the material aspects of words to highlight odd and contingent connections that might occur between their meanings, for example through suggestive assonantal echoes (for example, 'chars' and 'parts', 'the lake the look', 'center' and 'excessive.' We are left with vague cognitive suggestions, based on these aural linkages, that the fish (chars) are ecosystemic parts of wholes, that the lake exists in our 'look' (perhaps as reflection in our eyes, perhaps as the representation of experience), and that ideas of 'center' somehow *are* 'excessive' (which certainly dovetails with contemporary systems-theory thinking on ecosystems). As Hejinian sees it,

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[372] Marjorie Perloff *21st Century Modernism: The 'New' Poetics*, Blackwell Manifestos (USA and UK: Blackwell Publishing 2002), p.185.

> ‘In the course of the experiencing of experience, poetic language puts into play the widest possible array of logics, and especially it takes advantage of the numerous logics operative in language, some of which take shape as grammar, some as sonic chains, some as metaphors, metonyms, ironies, etc. There are also logics of irrationality, impossibility, and a logic of infinite speed. All of these logics make connections, forge linkages. That, indeed, is the function of logics; they motivate the moves from one place to another. But the emphasis in poetry is on the moving rather than on the places – poetry follows pathways of thinking and it is that that creates patterns of coherence. It is at points of linkage – in contexts of encounter, at what André Breton called *points sublimes* – that one discovers the reality of *being in time*, of *taking one’s chance*, of *becoming another*, all with the implicit understanding that *this is happening*.’[373]

When we seek to understand texts we tend to look for connections, but in a text that rejects closure we have to supply our own – or at least do some heavy lifting in interpreting those clues that are offered. Hejinian makes an intentional move to exploit this tendency in her work and to present a multiplicity of possible relations. That derives from an apparent perception that a Jamesian focus on relations can enlighten us both textually and biologically, because it helps us to address the perceived need to capture or model the complexity that is found in both types of system. She describes what she is seeking in the following passage:

> ‘a mode of writing that could be multiply referential, densely contextual, with a capacity to be periodically surprised by its own inherent logics [...]. I also wanted a mode that was maximally enjambed, because I felt things to be under the pressure of abutment, contingency, and contiguity and hence constantly susceptible to change. *One had to think quickly if one were to catch the ideas – the relationships – between things’* [my emphasis].[374]

In these poems, Hejinian’s textual elements exist in a state of flux, potentially as hyperconnected as ecological elements. In ecology, connections are what allow entities to exist as constituent parts of a complex system, to be self-organising and hence to escape entropy in a process of continuous renewal and adaptation. ‘Interconnectedness’ (or Morton’s ‘mesh’), is often invoked lightly in ecocriticism, but in this poetry there really

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373 Hejinian, *The Language of Inquiry*, p. 3.
374 Hejinian *The Language of Inquiry,* p.8.

seem to be useful parallels to be drawn between the structures underlying the textual system and the biological one – not least the realisation that context really is everything, for words ***or*** mud turtles.[375] Through the formal organisation of 'wild' language Hejinian is able to process both experiential and conceptual aspects of the world, and to think through ecological connections and relations, however contingent, stochastic or multiple they may be, in a way that renders them cognitively more available to us.

The defamiliarising effect reminds as that, as a systems theorist or more radical ecologist might see it, there are in fact no 'things' at all. There are only relations, patterns, and self-organisation. We might create cognitive taxonomies of individual animals, but these are just our perceptions of patterns of order that coalesce and dissolve in a passage of information and energy, a thickening and reorganisation of atomic bonds. Even words are simply a shifting flow of contexts, to use Hejinian's phrase. As Hejinian and Clark suggest in their poem, in one sense the water really **is** the spider. Anything else, as with ecosystems, is just 'reading in' in a way that is not so very far removed from the organising narratives of early ecology. Hejinian's essays, however, save us from descent into absolute relativism. We might be re-figuring our notion of figure and ground to incorporate the idea of relations as an important aspect of reality, but *things* are still important; and even relativism can be triangulated. What Hejinian's work really does here is to acknowledge the approximate nature of knowledge (perhaps not surprisingly, given her commitment to Jamesian pragmatism), one of the crucial insights of 20th century science.

There is also the problem that complexity theory tells us that information is distributed throughout the entirety of the system. In literary theory and philosophy, this notion is often translated into the idea of distributed consciousness, in that consciousness or agency can be found outside the subject. In one sense there is an obvious correlation between a post lyric-subject text and a philosophy of this type, and it is tempting to apply these theories directly to the poetry we have been discussing and to use the entire text as a model for the 'distributed field' of consciousness of an individual. But poems are not individuals. We can look at the poetry of Colin Simms, which certainly foregrounds the invocation of the human and the nonhuman and questions the position of the observer, but this exercise does not involve a category error on a par with figuring the poem as itself alive. The closest we can

375 Morton, *Ecology without Nature.* See for example also Oppermann, quoting Campbell, 'we belong not only to networks of language and culture, but also to the networks of the land.' Oppermann, p. 121. Quotes Campbell, SueEllen 'The Land and Language of Desire: Where Deep Ecology and Post-Structuralism Meet.' The Ecocriticism Reader: Landmarks in Literary Ecology. Ed. Glotfelty, Cheryll and Fromm, Harold (Athens: University of Georgia Press, 2003) pp. 318-43 at p. 211.

come to this idea is that of the distributed poetic system, in which consciousness is found particularly in two aspects of that system, in writer and reader, and at a further stretch, in some aspects of their respective contexts.

5. Nested ecosystems, nested texts

Hejinian is also interested in the idea of microcosms. A microcosm is something that an ecologist occasionally resorts to studying in order to understand something about a larger system. Of course, microcosm and nested systems are dangerous because of the temptation once again to end up comparing part with whole. Capra connects the idea of nested systems with the idea we came across earlier of the human as a composite superorganism:

> 'today we know that most organisms are not only members of ecological communities, but are also complex ecosystems themselves, containing a host of smaller organisms that have considerable autonomy and yet are integrated harmoniously into the functioning of the whole. So, there are three kinds of living systems – organisms, parts of organisms, and communities of organisms – all of which are integrated wholes whose essential properties arise from interactions and interdependence of their parts.'[376]

These nested systems are described as stratified autonomy in complexity theory. Systems arrange themselves in layers of integration within one another and each system is simultaneously autonomous and integrated with the systems at its level, below and above it. We are reminded of the requirement to think in terms of layers of organisation, ecologies and when we think about texts. However, the hierarchical language is misleading. It might be better to see language as a nested system within ecology, than to place it alongside ecology.

The idea of nested systems within systems reminds us in a visual sense of the notion of self-similarity and repeating pattern. Of course a lot of poetry, both within and outside the modernist tradition, has played with notions of nested systems, layers of organisation, form, pattern, fractal, Eigenform and so on. Gertrude Stein's attitude to repetition, which is not repetition, could usefully be read this way. With particular reference to Language writing, Ron Silliman's exercises in 'Tjanting' and 'Ketjak' come to mind. In discussing the fractal forms of 'Mohawk' and 'Ketjak' in *L=A=N=G=U=A=G=E*, in 1978 Ron Silliman wrote a brief note about a recent article in *Scientific American* on fractal curves in music, and

376 Capra and Luigi, p. 67.

explicitly tied the fractals that occur in nature (that is, the irregular self-similarity of coastlines, rivers, trees, star clusters), to self-similarity in language – which is also 'irregular'.[377] It seems likely that Hejinian would have been aware of this.

Capra calls our attention to:

> 'the striking growth pattern of sunflower seeds, which features two sets of interpenetrating spirals, one running clockwise and the other counterclockwise. Typically, the number of spirals in each set turns out to be two consecutive Fibonacci numbers. This means that the golden angle is the generative principle of this pattern'.[378]

Hejinian and Collom depict this in the text of 'Sunflower': layers of organisation seem to figure as movements that 'stood on top of each other', but in their version conceptual hierarchy of stacked systems is 'teetering', always filtered through phenomenology which is itself filtered through our Husserl-based ideas of phenomenology:

> 'Spiral, or weave. The sun is already divided
> Into a hundred arcs, variant versions of itself, clubbed in the positive
> And banding in the negative, just as late yesterday, in muddled silence,
> All these movements stood on top of each other, teetering, pale
> As the words "jeremiad" and "idiosyncrasy." At night in fall the sunflowers
> Are filtered through sounds like "Husserl" and arrive a little bluer
> Than the sky'

In Hejinian and Collom's version of nested self-similarity, words, sentences, and conceptual schema exhibit irregular self similarity as well as similarity with the phenomena of the natural world that they invoke.

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377 Ron Silliman 'Mohawk' and 'Ketjak' *The L=A=N=G=U=A=G=E Book*, eds. Bruce Andrews and Charles Bernstein (Carbondale and Edwardsville, Southern Illinois University Press, 1984), p. 270

378 Capra and Luigi, p. 177.

CONCLUSION

'BRICOLEURS AND MAGPIES'

> 'If one sets the bar for the development of systems theory this high, one must expect that systems theory will continue to have only a minor impact on literary studies. But one can also argue that [...] systems theories actually offer a relatively straightforward framework and a useful toolkit of concepts that can produce new and important insights about the nature and role of literature in a world-historical context. For example, Luhmann's basic diagnosis of modernity can be immediately helpful to working literary critics, who are not chiefly theorists but bricoleurs and magpies.'
>
> Andy McMurray,
> *Systems Theories and Literary Studies*[379]

> 'Eugene and Howard Odum, Margalef, Slobodkin, and others viewed ecosystems from a variety of perspectives, frequently reasoning analogically from physical, chemical or biological systems to ecosystems. The condition of ecosystem studies at this time might be characterised by Claude Levi-Strauss's term *bricolage*, which refers to the construction of an object or a theory from a variety of unrelated, found materials. The *bricoleur* arranges these and create something new and unexpected from the disparate materials.'
>
> Frank Golley,
> *A History of the Ecosystem Concept in Ecology* [380]

> '"*A*" is a bricolaged monument that is propositional in its means.'
>
> Jed Rasula, *This Compost*[381]

1. 'Things of each possible relation hashing against one another'

Lyn Hejinian and Jack Collom's 'Sunflower' is in one sense reminiscent of Juliana Spahr's 'Things of each possible relation hashing against one another': neither poem offers a definitive view as to what we should make of the hashing together of the ecological 'things' within it, and both are also densely referential, permitting several readings by way of their

379 Andy McMurray 'Systems Theory and Literary Studies', in Arnold, *Traditions of Systems Theory*. In referring to setting 'the bar this high', McMurray means the practice of looking for an exact correlation between systems and literature.

380 Golley, p. 109.

381 Rasula, *This Compost*, p. 83.

unconventional formal qualities. This poetry self-consciously foregrounds the physical site of its language as the site of meaning-making, partly in order to kickstart our cognitive processes, to refresh language, and to estrange the world by refocusing our attention on connections rather than on that which is connected. It is difficult to read because of the inherent uncertainty arising from its attenuated hypotaxis, and because in its plurality it demands a great deal of processing power, demanding the constant reassessment of contextualisation. This is language as praxis and poiesis, language that pays attention to its own physical aspects as well as to the murkier dimensions of its denotations and connotations. In line with Bernstein's 1989 manifesto, it is self-consciously difficult poetry, and it is consciously complex too, in the proper meaning of that word.

Much of the work that this type of poetry does in exploring the complexities of ecological relationships comes back to acts of reframing and recontextualisation, and in particular the exploitation by collage and bricolage of found materials and disparate ideas, as a principal source of its connections and disconnections, its order and disorder. In what textual and ecological relationships do the egg, the wren, the ur-owl, and the sunflower stand? This question seems to echo the question that Gregory Bateson posed in 1979:

> 'What pattern connects the crab to the lobster and the orchid to the primrose and all four of them to me? And me to you?'[382]

On every reading, 'Sunflower' constructs its relationships and connections anew, forcing us to acknowledge the impossibility of understanding complex connections even as it recognises that we cannot help but seek them. The textual system itself seems to anticipate catastrophe and to slide into new and stable states of meaning, affording glimpses of the order and disorder found in every system that hovers at the edge of chaos. It also hints at the point at which we 'can connect/nothing with nothing' which is, it seems, the point of death, of the total entropic disorder that is the ultimate fate of all complex systems.[383]

The overriding urge to make connections, create metaphors, and draw analogies, to *analyse* the 'things of each possible relation hashing against one another', seems to be hardwired into our consciousness. Patterns are pleasing, whether we find them in the self-similar form of an organism that is organised according to the Fibonacci sequence and the golden ratio, or create them in poetry or in our critical capacity. That is, aesthetic appreciation is itself a

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382 Gregory Bateson, *Mind and Nature* (New York: Dutton 1979), p. 8.

383 T.S. Eliot, *The Waste Land*, l. 301-2, *Norton Anthology of Poetry*, 5th edition, ed. Margaret Ferguson, Mary Jo Salter, & John Stallworthy (New York, London: W.W. Norton & Co., 2005), at p. 1352.

type of thinking, and represents one way in which poems offer a thinking space: the aesthetic and cognitive dimensions of poetry are not, it turns out, a binary at all.

We are obeying the urge to seek patterns when we compare poems and ecosystems, but because the ecosystem concept is itself unstable we enter a type of phase space at this point (to use another dangerous metaphor). The underlying ideas in the history of the ecosystem model include stability and progression, they speak to our desire for an orderly and progressive narrative, and they are inherently anthropocentric. Complexity science itself also reveals the desire for a deep layer of order: the etymology of the word 'complex', from the Latin *complexus*, to braid or twine, tells us something significant about how we view our subject matter. To braid or twine is to draw disparate stands into ever more complex, ordered, and close knit relationships. This etymology seems to demonstrate a greater emphasis on order and deliberate arrangement, part and whole, merger and recontextualisation, than on disorder. This 'braiding' recalls Pound's description of collage as the 'ply over ply' method, again connecting complexity science with experimental poetry.[384] Collage has been described as the convergence between modernist abstraction and the realism of the photographic fragment, and it always invites analogy by bringing things into relation, comparison, and transition.[385] Within this broad collision between abstraction and realism, collage offers a richly divergent cognitive domain in which the incessant recontextualisation of materials engenders a continuous and dynamic double reading, of fragment in relation to origin and fragment in relation to new context, a double reading that Marjorie Perloff has characterized as 'oscillation'.[386] The continuous oscillations of this poetry, and indeed of any paratactic bricolage of ideas such as those that inform our analogical exercises, including our metaphors, produce transformative tensions, putting objects and processes into vibration with one another, and revealing an altered dynamic. Yet the cognitive oscillations of reading this work are as far beyond the range of our senses as are the sub-visible oscillations of radiation that we call light waves; both have a detectable effect that we can register but we cannot observe their operation at source.

The oscillations of Zukofsky's, Hejinian's and Simms's materials operate to dissolve existing borders and boundaries, achieving new integrations. It is possible to think of these

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384 'Complex', *Chambers Dictionary of Etymology*.

385 Patrizia McBride, 'The Game of Meaning: Collage, Montage, and Parody in Kurt Schwitter's Merz', *Modernism/ modernity*, 14 (2007). McBride is referring to Christopher Phillips' paraphrase of the German art historian Franz Roh's remark.

386 Marjorie Perloff, 'Collage and Poetry', in *Encyclopedia of Aesthetics*, ed. by Michael Kelly (New York, USA: Oxford University Press, 1998), pp. 384-87 and 406-10., accessed online at http://marjorieperloff.com/stein-duchamp-picasso/collage-poetry/ on 05 December 2014.

poems as being re-braided or enmeshed into new cognitive patterns that are simultaneously both fractured and atomistic, retaining their old semantic relations, and which also constantly achieve new 'organic' wholes by way of their dislocation and re-contextualisation. This poetry offers an experience that is at once disjunctive *and* hybridised, delicately negotiating 'boundaries' that are simultaneously open and closed, offering both a reductive and a holistic approach to the ecosystem and its secrets. Once again, the vocabulary of complexity appears to be directly applicable to texts. When the complexity scientist Erich Jantsch wrote that 'The dynamic existence of nonequilibrium structures is not only characterised by continuous oscillation and self renewal, but also by the impossibility of ever achieving absolute stability' he could have been describing experimental poetry in line with Perloff's characterisation, instead of discussing autopoeisis.[387]

It is not only in its bricolaged possibilities that experimental texts seem particularly appropriate to any discussion of complexity. Most poetry engages with the question of knowledge and how we know what we think we know, but the lineage of poets that appears in this thesis seem to deal in particular with what and how we can know through language, and more specifically how language as a complex system or field structures our experience of the complex world around us. Hejinian, Stein, Simms, and Zukofsky have not been studied as systems thinkers, and this is an obvious critical gap in view of their poetic approaches.

2. The ecosystem and the ecotext

So how and where might texts and ecologies intersect? And how can we study these points of relation? As I have argued, it seems that we need to extend our ecocritical scope to cover not just 'literary' texts, but science and popular science too; and not only to work that overtly and primarily concerns itself with the natural world, such as ecology or ecopoetry, but also to work that does not, such as cybernetics. All of these fields operate as both our subject matter and our thinking space. They are not as distinct as we often assume, and they cannot be studied in isolation; each must be refracted through the lens of other discourse.

Yet even in describing the scope of work that needs to be done certain problems become apparent, because what, for example, *are* 'ecopoetry' and the related 'ecopoetics'? These are ideologically weighted words, connoting as they do ethics, environmentalism, an emphasis

387 Erich Jantsch *The Self Organising Universe: Scientific and Human Implications of the Emerging Paradigms of Evolution* (Oxford, New York, Toronto, Sydney, Paris, Frankfurt: Pergamon Press, 1980), Systems Science and World Order Library ed. Ervin Laszlo, p. 41.

on accountability, and a certain amount of ecological piety. Broadly suggestive of a collision between the poetic and the ecological, these categories are at once both elusive and heterogeneous. In part this is because of the (sometimes necessary) hyper-alertness of ecocriticism to the ideological dangers inherent in its available lexicon – most particularly in staple terms such as 'nature' and 'environment'.[388] In line with this, ecopoetry and ecopoetics are sometimes expressed in opposition to their often-maligned relatives and antecedents, 'nature poetry' and 'nature writing', which are depicted as uneasy attempts to transcribe the world textually and culturally that foreground their materialist credentials whilst seeking to hide the ideological and cultural dimensions of their practices. Anxiety over the idealisation and reification of nature seems to feed into much of our earliest ecocritical work, often coupled with the appealing suggestion that we might escape these problems by the sustained exercise of redefinition and differentiation – one consequence of which is an ever-growing but disparate critical vocabulary. Yet, as we have seen, this hyper-alertness is selective: we can be suspicious of the word 'nature', but casually invoke the 'ecosystem' or 'complexity' as though these are entirely transparent concepts.

Juliana Spahr offers one example, cited by a number of poets and critics, of just such a negative depiction of 'nature poetry':

> 'Shortly after I moved to Hawai'i I began to loudly and hubristically proclaim whenever I could that nature poetry was immoral. […] I was more suspicious of nature poetry because even when it got the birds and the plants and the animals right it tended to show the beautiful bird but not so often the bulldozer off to the side that was destroying the bird's habitat. And it wasn't talking about how the bird, often a bird which had arrived recently from somewhere else, interacted with and changed the larger system of this small part of the world we live in and on.'[389]

Spahr's striking pairing of the visible bird and the invisible bulldozer usefully sums up some of the perceived problems with nature poetry by juxtaposing two material objects drawn

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388 For an extensive discussion of this problem – and also for an example of ecocriticism that thoroughly impales itself upon the perceived nature/culture dualism – see for example Morton's *Ecology without Nature.*

389 Juliana Spahr, *Well Then There Now*, (Hampshire New Jersey: Black Sparrow, 2011)., p. 69. Spahr's bulldozer/bird description has been quoted by Durand in 'The Ecology of Poetry', by Dianne Chisholm (Dianne Chisholm, 'On the House That Ecopoetics Builds: Juliana Spahr's '"Eco" Frame'', *Textual Practice*, 28 (2013)., p. 632, and Dianne Chisholm, 'Juliana Spahr's Ecopoetics: Ecologies and Politics of the Refrain', *Contemporary Literature*, 55 (Spring 2014)., p. 119), by Jonathan Skinner (Dean Kuipers, 'Easy Being Green: W.S. Merwin Brings a Strong Eco-View as the Next U.S. Poet Laureate', *Los Angeles Times*, (2010), and by Christopher Arigo (Christopher Arigo, 'Notes toward an Ecopoetics: Revising the Postmodern Sublime and Juliana Spahr's This Connection of Everyone with Lungs', *How2*, 3 (2008)).

from different realms that effectively operate as metonyms for those domains: the 'natural', living, nonhuman bird, and the bulldozer, which figures as a manmade instrument of destruction that is never acknowledged in this poetry. Spahr's description neatly encapsulates many of our lingering ecocritical anxieties about the invisible, destructive, constructionist, and thoroughly cultural practices of 'nature poetry', as well as suggesting in its final sentences that this is poetry that does not engage with the complex interactions of the natural world.

'Nature poetry', we infer, often fails to engage productively with the knowledge and methodologies offered by other discourses such as science, and fails to acknowledge human intervention or 'non-charismatic' species. This nature poetry offers a nature and culture that are at odds with one another, and moreover a situation in which the monstrous figure of culture is all the more alarming for being unseen, always just off to one side of the frame. As Spahr draws attention to the way in which 'nature poetry', as she sees it, elides or glosses over the bulldozer's presence, we detect the suggestion that there is some likeness between nature poet and developer, nature poem and bulldozer – or, at the very least, some complicity between them. Indeed, reading this description in isolation one might be forgiven for thinking that Spahr was advocating the type of self-consciously environmentalist poetry at the opposite end of the spectrum, a poetry that is full of bulldozers and highly polemical. But that is not where her thinking leads, instead tracking back to the fashionable intricacies of complex systems theory.

In a similar vein to Spahr, Marcella Durand writes that 'traditional Nature poetry, à la the human-subject meditating upon a natural object-landscape-animal as a doorway into meaning of the human subject's life, is now highly problematic'.[390] It is unclear whether Durand means that this practice is now *seen* as highly problematic, or whether she means that it has become problematic as a result of incipient biodiversity and ecological crises, but in either case, Durand similarly draws attention to the fact that in the longer tradition of nature poetry 'Nature' is often represented as a mirror to culture, read as an alienated 'Other' to the human subject, employed to elucidate something about the subject.

It may not be as easy to say what ecopoetry and ecopoetics are (or perhaps more accurately what, as critics and poets, we would like them to be) as it is to say what they are not, but it is useful to make the attempt, even as we acknowledge that we are trapped in our own cultural moment and any attempt to scope out the parameters will reflect our critical and ideological

[390] Durand, p. 59.

conventions. Most definitions of both ecopoetry and ecopoetics seem to take as their focus ethics and/or environmentalism, and some explicitly foreground complexity, or human/nonhuman relations, or interdisciplinarity. For example, Jonathan Skinner has discussed ecopoetry as the 'site of interstices, conjunctions and convergences, ecotones, and interdisciplinarity' in what can be seen as an updated and improved version of that basic of ecocriticism, the idea of interconnection. This accords both with a suggestion by the ecocritic Richard Kerridge that ecopoetics seeks to break out of its own cultural niche and to break science out of its cultural niche as well, and with Gary Snyder's characterisation of ecopoetics as a 'fungus' that breaks down disciplinary boundaries and digests the 'symbol-detritus.'[391] That is, ecopoetry might be something that is intrinsically connective, systemic, interdisciplinary, and dialogic.

Juliana Spahr follows up her disparagement of nature poetry with a call framed in the language of complexity, suggesting that an ecopoetics might perform a 'systemic analysis'. Whilst perhaps this simply indicates the historical moment in which we find ourselves and the cultural trends that feed into our thinking, it is nonetheless a useful starting point:

> 'And then I realised that what I was looking for all along was in the tradition of ecopoetics – a poetics full of systemic analysis that questions the divisions between nature and culture – instead of a nature poetry.'[392]

Spahr chooses to contrast the nature *poems* that are grouped according to a common subject matter ('nature', whatever that is) referred to in the earlier citation, with an eco*poetics* – that is, a set of compositional and political principles, which assumes a reasonably cohesive body of thought and work. Perhaps this is the first element by which we can identify ecopoetry: that is, that it has its own collective poetics, and furthermore this is a poetics that is 'full of systemic analysis'.

It is possible to take this notion further. Ecopoetry (and the ecopoetics that underlie it) operates as both analysis and thinking space partly by virtue of its capacity to offer us mental access to the world by way of modelling its complex dynamics. Beyond simply rephrasing well-rehearsed ecocritical and wider literary critical arguments about form-to-meaning correlations (such as the idea that the poet can use mimesis to depict the sensory, aesthetic or affective qualities of experiencing nature, the bulldozer and the bird), this

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391 Both Jonathan Skinner and Richard Kerridge were speaking at a Southampton University symposium on poetry and ecology in 2012. See also Snyder, *The Real Work*, at p. 71.

392 Spahr., p. 71.

research suggests that there is a structural congruence between texts and ecologies at a deep level which enables critical readings that explore a kind of deep embedding of our cultural models of the Earth in the very structure of the text. That is, ecopoetry seems to afford multiple ways of modelling our encounters with our environment and its other inhabitants, but also to register how other discourses represent those encounters. We might plausibly conclude that one hallmark of contemporary ecopoetry is the way in which it goes beyond earlier texts in formally exemplifying and even interrogating the hidden ideologies within these metaphors and models. It is a poetry that models models. In the case of more recent innovative poetry, these deep structural analogies often seem to be deliberately foregrounded for the reader, through the inscription of ecosystems, and other ecological structures and relationships, in the techniques and material forms of these texts; in other poems it can legitimately be 'read in.' We might perhaps characterise a reading on this basis as looking for the 'ecotextual' elements of a given work.

Spahr's notion of a 'systemic' analysis also helps us in terms of critical approaches to this type of poetry. As part of reading this work we can return to many of the theoretical models of the 20th century: perhaps as a result of the common cultural history that informs literature and science, the tools are already there. For example, in his book *Complexity & Postmodernism*, Paul Cilliers proposes that distributed representation, which in turn is linked with distributed modelling techniques and connectionism, can be used to theorise about the linguistics of text. We can also bring into play the work of the American pragmatists in the semiotic analysis of texts, and particularly Charles Sanders Peirce. For example, Peirce's theory of the sign is based on a triadic arrangement, the first element of which approximately corresponds to Saussure's signifier (representamen), the second of which is the semiotic object or real-world referent, and the third of which roughly corresponds to Saussure's signified, but with important distinguishing features: the interpretant – the idea, mental image or sense that is made of the sign, taking into account relevant temporal and cultural factors.[393] This diachronic emphasis on mechanism or process of language, rather than on the Saussurean attempt to analyse language synchronically as a structural system, acknowledges the social and dialogical aspects of language; it permits of a greater element of precision in describing language as transmission, and a temporal and cultural deictic

[393] The existence of the real-world referent in Peirce's philosophy marks a difference from the Saussurean focus on the sign, and a greater difference still from the ideas of those poststructuralists who do not accept the existence of an extra-linguistic reality. Peirce acknowledged that every interpretant entails formation of a further interpretant, resulting in what Peirce called 'unlimited semeiosis' – a type of infinite regress similar to Derrida's deferral of meaning. Bakhtin and Vološinov proposed a similar model.

anchoring of each linguistic act, but also acknowledges an active individual role for the recipient in forming the interpretant, an element of slippage between creator and receiver.[394] By extension, it supports the possibility of the reader's active interpretative role in the thought experiments of poetry. Although this model predates Shannon and Weaver's theory of communication by some decades, it is much more apposite for our purposes (not surprisingly, given the original purpose of Shannon's paper).

Peirce's classification of various types of representamen/object/interpretant relationship is also interesting in the context of the discussion on Prynne and Weaver as to the arbitrariness or otherwise of the signifier, particularly in Peirce's description of two particular linguistic modes whereby the representamen is not arbitrary but connected to, or restrained by, the interpretant (the indexical mode, including indexical words like 'this' and 'that', and the iconic mode, in which the respresentamen in some way seems to resembles the interpretant, at any rate in the eye of the beholder – for example onomatopoeia or metaphor). As Kent Grayson has noted, this apparent degree of transparency and connection can mislead: 'instead of drawing our attention to the gaps that always exist in representation, iconic experiences encourage us subconsciously to fill in these gaps and then to believe that there were no gaps in the first place [...] This is the paradox of representation: it may deceive most when we think it works best'.[395]

Grayson comments that 'representation in science is different in many ways from representation in art. Yet, one of Peirce's main contributions is to highlight that a sign operates via the same mechanics [...] The connection between representation in art and in science is also extensively analysed by Gadamer (1996), who argues that both modes of communication share a number of critical philosophical underpinnings'.[396] The use of language as a medium for poetic thought experiments suggests a method of inquiry that is in some respects alien to the aims of science and philosophy, as they are usually understood, and in others surprisingly similar: as Robert von Hallberg suggests, 'vagueness and error are inevitable constituents not only of poetry but of analytical thinking as well'.[397] There is a parallel between the action of poetry and the conceptual modelling of philosophy, but philosophical and scientific thought experiments tend to be more complete, more

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394 The Saussurean insistence on the validity of a synchronic mode of analysis has been criticised by many, including Jakobsen, Bakhtin, Vološinov, etc.

395 Grayson, Kent 'The Icons of Consumer Research: Using Signs to Represent Consumers' Reality', from *Representing Consumers: Voices, Views and Visions*, ed. Barbara Stern (New York, NY: Routledge, 1998) pp.27-43, at p.41.

396 Grayson, p. 37.

397 Von Hallberg, p. 113.

paraphrasable, perhaps more linear, and seek to eschew the more ambiguous connotations and resonances of language that poetry actively exploits. All these discourses have sought to model, represent and analyse phenomena that do not makes themselves easily available to cognition.

If Peirce's triadic rearrangement acknowledges cultural feedback and memory, there are other systems thinkers throughout the course of the 20th century whose thinking and analyses could usefully be brought to bear in a similar way on texts. Wittgenstein's language games offer one choice, and Umberto Eco and Roman Jakobson have also specifically incorporated ideas drawn from biology and systems theory into their work. We have already seen how Lakoff and Johnson are relevant for the purposes of this theory. The process philosophy of Alfred North Whitehead is also relevant here, as is the work of Bruno Latour (which is ripe for a re-evaluation) and Deleuze and Guattari, all of whom are systems and/or complexity theory thinkers in their way, and further work could usefully incorporate these trends. All of this returns us to Spahr's suggestion that this type of poetry can offer a systemic analysis: ecopoetry might be a way of looking at the earth in a way that seems to accept and interrogate scientific and other discourses such as systems theory, and it delivers this analysis not only through content and a particular ethical-political stance, but also through the operation of poetic form and technique and the aesthetic qualities of the poem, producing a formal and substantive synthesis of our models and notions of nature.

Moving beyond the ideas of ecopoetry as modelling the Earth or our scientific models of it, the question as to whether there is a true homology between textual and natural systems seems more problematic. One thing that does become clear is that the biological science of the 1940s, 1950s and 1960s maps just as inadequately to poetic texts as to natural systems, which does seem to support the homology suggestion. With the coming of second-order cybernetics, however, many of the dimensions of how we think about biology and how we think about texts begin to coincide. As we reach complexity theory the confluences are much more obvious, but this does not necessarily indicate that they are related; to make that assumption would be to make the same error as to think that an ecosystem could be conscious, or selected for, simply because its properties of emergence appear to bear some resemblance to the properties emergent in individual living things, which is a recurring comparison in our models of the ecosystem. Text to ecosystem comparisons do not reveal homologies whose accuracy can be confirmed, and, worse still from a scientific standpoint, the hypothesis that a text is a type of complex system or that a text is an ecology cannot even hypothetically be falsified, plunging it into the dark realms of myth. Whilst myths and

narrative shape our fictions for a reason, they are perhaps less appropriate to the type of poetry that I have examined in this thesis, and they can be dangerous when they underpin the language we use and the assumptions that we make when we study the Earth.

I have tried to show the scope and breadth of the potential in bringing an analysis of ideas drawn from the ecosystem concept in ecological science to bear on an analysis of ecological poetry. It is of necessity not as extensive as it could be, given the constraints of space, but the work that I have done demonstrates the potential for this type of study, and the need for it to be extended. Clearly, there is danger in this type of broad analysis, which is related to the dangers of loose analogising between texts and poems and the vague use of ideas of interconnectedness. That does not mean it is not worth the effort and risk. Even though we cannot make out the full range of comparison between ecological and textual systems, there are specific aspects of literary work that complexity theory gives a name to and helps us to elucidate in our own minds. The paradoxical relationships between simultaneously bounded and non-bounded entities that occur within text and ecosystems represent one example of a cross domain comparison that we might not have been alerted to in the absence of complexity theory. The way in which Hejinian, similarly, problematises our notions of what is part, what is whole, and what is the relationship between them, is conducted as an extensive project that stretches across her work.

The ecosystem is a measure or a model but it is also a myth. We can detect the influence of the ecosystem narrative within our understanding of science, and we can detect a common zeitgeist that gives rise to both discourses and explains some of the resemblances between them. It could be that it is here that we can genuinely connect the ecosystem with our texts. Poems and ecosystems are both models, forms of representation, schemes of knowledge, thought experiments. One of the insights that is actually offered by the idea that the process of meaning-making happens within and on contact with the text, especially with more complex texts, is a simple one: we are presented with the text and it is hardwired in us to treat it that way, to start to make meaning and construct our models, in just the same way that we do when we look at the complexities of the natural world.

I have argued in this thesis for the idea that our system of poetry is both a mode of cognition and a dynamic repository for knowledge as well as a type of cultural memory. Thinking is achieved through the observation and processing in the activities of reading and writing poetry; feedback occurs at an individual and a systemic level in learning and cultural change. The unique linguistic and formal potential of poetry facilitates an approach to the otherwise

unassailable complexities of biological and textual systems. This argument seems to be most persuasive when applied to linguistically innovative work in either a modernist or postmodern tradition, because experimental poetry is not only complex, but also deliberately and self-consciously foregrounds and explores its own complexity. It does so by offering multiple possibilities for the emergence of meaning, affect, and aesthetic experience, which derive from its incommensurables, paradoxes and multivalencies.

Whilst certain authors seem deliberately to have sought out and tried formally to represent these ecological and textual confluences as a part of their poetic practice, the work of others may contain formal text to world correlations that are more latent, perhaps resulting from a passive, even unconscious collection and re-presentation of culturally and naturally inflected forms and structures by their authors. Sometimes the ecotextual elements of a work might exist only as a result of particular interpretive activities of readers, as determined by the wider context within which they read. Nonetheless, seeking out these confluences as readers and critics is undoubtedly helpful in thinking about how we model the Earth as a living system, not only because the analogies we draw change with time, but also because understanding those changes reveals the hidden structures that underlie our thinking and, by extension, reveals the source of our actual interactions with the ecosystems we inhabit. This might well give us a stronger ethical positioning, especially in terms of human/nonhuman interactions, because of the deconstruction and exposure of hidden linguistic and epistemic features and the related exploration of perspectival limitations. Put simply, how we think of the Earth determines how we inhabit it, and we should prioritise anything we can that helps us to reveal this thinking to ourselves.

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Appendix 1

Text of 'The Lake'

Forms rise at pleasures the whole wanders
Clouds are forming but never come to what they form
In loops, in towns of arachnids
It is said to be lake divides

How does one think nonetheless emotions?
There is girting on the inside of the sands
Insistently
And the lake returns the pressure

The mud turtles, the light chars
They are the loose parts known as passions for connections
And what's on the periphery but touchstone
And even this can't be equated

Skims delve on a furbisher
The lake the look abstractly

It is discomfitted by emotion at what account?
Each rend takes another position
a
re-
place-
ment
partially

an overlapping
differs from a shared
aftermath
the site is part
increment a
lake can be seen
as a strong inclination a
suspended
barrier or a
sunken measure
emotion is meant with sensation
shapes
where
lake
doesn't
desist

Namely connivance
Namely congratulation
Noon continues to cease

Namely amphibian
Namely southbound

If there can be separation
Sporadically
A site of shared denotation

A particular thinking on a lake
in passing as a lake
is held and then a separate thought
of a lake
The water is the spider
It is tied to the shift
We call center to the outside
We call excessive
The lake balances away

12 into
9, 7
into 5,
4 into 3 times without sarcasm
It's a windblown reclamation
The encroaching surfaces center the lake stares down
A lake
that can face
settles freezing

There are loons in coils and millfoil to disclose
And perhaps it's all internal

The spit is defensible
though the rocking
required
is by bucketfuls
This is guesswork, abduction
Wherever there is
trivia there is
vicissitude and issue
of emotion
guesswork, abduction

Lyn Hejinian and Emilie Clark, *The Lake*, (New York: Granary Books, 2001).

Appendix 2

Extract from 'Sunflower'

Philosophy ought to hesitate, use commas when it uses words,
So continuance's spirit, at least, might, yes, fleece,
Spiral, or weave. The sun is already divided
Into a hundred arcs, variant versions of itself, clubbed in the positive
And banding in the negative, just as late yesterday, in muddled silence,
All these movements stood on top of each other, teetering, pale
As the words "jeremiad" and "idiosyncrasy." At night in fall the sunflowers
Are filtered through sounds like "Husserl" and arrive a little bluer
Than the sky, though "pure consciousness" encountering "the appearance of things" may cloud
The sunflowers, uns*lf worse, into "ur-owl-ness (f)"
(The word itself fouls wrens) and the iron shelters for the border guards bound by the strands of rain.
A moment of silence. Then a rise to the top of things: the ever-present tiny leaps:
The links (as late as yesterday). Today it really rained, or something else repeated,
If the rhythm of real/ unreal is really repetition. I was eating eggs
And anticipating (anticipation is always dependent on the senses)
A spunkier texture than I'd been used to, whereas each new parenthesis paused to introduce ... a joke, nothing structural,
Although contingent – sudden, but to the point – or, rather, now that I think about it, missing the point, but intentionally, so as to defer
As it were, the bestowal of a middle name on Relativity Theory, and all the attendant
Dissipation, skywriting [...]

Jack Collom & Lyn Hejinian Extract from 'Sunflower', *Situations, Sings*
(USA: Adventures in Poetry, 2008) pp 68-9

GLOSSARY

Autopoeisis	The process by which a system maintains and reproduces itself.
Bifurcation point	When a flow of energy through a dissipative structure increases, and the system gets further from equilibrium, it may reach a bifurcation point, and split into new forms of order.
Biome	The aggregate of all the organisms of a particular region, a term suggested by Clements in 1916.
Climax community	An ecological community in a steady state, achieved through succession.
Complex adaptive systems	Complex adaptive systems can be distinguished from other systems by (i) their capacity to conserve and process information; and (ii) their ability to 'learn'/ evolve new forms of behaviour based on it.
Dissipative structures	Dissipation (that is, the dissipation of energy in heat transfer, friction, etc.), instead of being associated with waste, is a source of order, in open systems.
Dynamical systems	Systems that change over time. These systems operate far from equilibrium and yet are capable of producing stable self organising structures.
Edge of chaos systems	Edge of chaos systems are complex adaptive systems that are poised on 'the edge of chaos' — stable enough to maintain the structure, but sensitive enough to external changes that they can undergo rapid and unpredictable periods of change. Life occurs here, where order and chaos are sufficiently intermingled to create coherent patterns, but never to let them 'freeze up' or 'boil away'.
Complexity theory	The study of how order emerges in complex adaptive systems.
Phase transition	A radical shift of the system from one condition to another with highly

	different properties. A phase transition can be first order (abrupt; either/or choice) or second order (continuous). On one side stands the rigid pattern of solid order; on the other the turbulence of chaos. In the middle, at the point of transition, stands a region of mixed order and chaos – enough order to have form, but enough chaos never to get rigid. This point of 'phase transition' is the 'edge of chaos' and is the condition that all living systems evolve towards.
Recursion	A procedure that is applied once, and then applied to the result of that application, and so on.
Succession	Succession is the process by which the structure of a biological community evolves over time.
Superorganism	Groups of individual organisms of the same species in a single site are conceptualised as though each group constitutes a complex organism undergoing cycles of birth, growth and development, or succession.
Trophic dynamics	The flow of energy as food within ecosystems.