

***LITERATURE AND SCIENCE WRITING IN
CONTEMPORARY CULTURE:
THE CHALLENGE TO HISTORY IN POST-
ENLIGHTENMENT DISCOURSES OF LITERATURE,
SCIENCE AND LITERARY THEORY***

**Thesis submitted for the degree of
Doctor of Philosophy
at the University of Leicester**

by

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Abstract

Literature and Science Writing in Contemporary Culture: The Challenge to History in post-Enlightenment Discourses of Literature, Science and Literary Theory

Daniel Cordle

This thesis examines the relationship between literature and science in contemporary culture. Section one explores the histories of literature, science and literary theory, from the Enlightenment to the present day, charting the ways in which parallel developments take place in each field. This version of history is justified by an analysis of the canon of texts and ideas to which 'postmodern' discourses make reference in explaining their current status.

This history also involves the replacement of a traditional model of the culture, in which literature and science stand in direct opposition to one another as 'two cultures,' by a new understanding. This new model sees the culture as an amalgam of various discourses, and makes possible an analysis of the complex interactions between literature and science.

Section two is comprised of three case studies, focusing on issues of knowledge, identity and time, which are used to explore this interaction of literature and science in contemporary culture, drawing out the ways in which it upsets binary distinctions that were key to Enlightenment thinking. The first of these is a comparison between notions of order and disorder in Thomas Pynchon's *Gravity's Rainbow* and popular presentations of chaos theory; the second explores the transgression of the human/machine and natural/artificial boundaries in William Gibson's *Neuromancer* trilogy and Richard Dawkins' books about evolution; and the third explores a turn away from the concept of progress in Kurt Vonnegut's novels and Stephen Jay Gould's *Wonderful Life*.

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INTRODUCTION

**STRIVING FOR HOMOLOGY IN
LITERATURE/SCIENCE
CRITICISM**

Introduction

Similarities come in many forms: some are guides to genealogical inferences; others are pitfalls and dangers. As a basic distinction, we must rigidly separate similarities due to simple inheritance of features present in common ancestors, from similarities arising by separate evolution for the same function. The first kind of similarity, called homology, is the proper guide to descent. . . . The second kind of similarity, called analogy, is the most treacherous obstacle to the search for genealogy. . . . Distinguishing homology from analogy is the basic activity of genealogical inference. We use a simple rule: rigidly exclude analogies and base genealogies on homology alone.¹

The problem which faces the palaeontologist striving to reconstruct patterns of evolution from fossil remains, here identified by Stephen Jay Gould, also besets the hunter of links between literature and science. Faced with the need to reconstruct the relationships linking an immense but fragmentary field of evidence, how do we ensure that the connections which we search out are genuine rather than illusory? We need to combine separate pieces of information in order to give them meaning, but a very real problem lies in ensuring that that meaning is correct.

For the palaeontologist the goal is to discount analogy completely and strive solely for homology. As Gould goes on to say, by way of illustration, bats and birds may both have wings but this similarity is deceptive, a seductive analogy which is liable to distract us into thinking that bats are birds, not mammals, if we are careless. Similarly, in searching for links between literature and science we must beware of seizing upon all similarities as evidence of genuine connections between the two realms. To find something in a work of literature which echoes science in some respect, whether in terms of form or content, is never difficult. The arduous task lies in distinguishing between that which is evidence of a real affinity, and that which is imposed by our minds' desire to find connections between the two. Similarities abound, but which are genuine manifestations of homology between literature and science?

The task is further complicated by the fact that we cannot make the strict distinction between analogy and homology called for by Gould, because our subject matter is so different to that of palaeontology. Whereas a palaeontologist is concerned with material homologies - deduced from the fossil record in which the inheritance and

¹Stephen Jay Gould, *Wonderful Life: The Burgess Shale and the Nature of History* (1989; London: Hutchinson Radius-Century Hutchinson, 1990) 213.

transformation of characteristics, as they are passed from generation to generation of creatures, appears - we are concerned with abstract, immaterial homologies. Instead of being concerned with whether bats are descended from mammals or birds, we might be interested in how *ideas about* chaos and order are manifested in science and literature, as is N. Katherine Hayles, or in how *ideas about* evolution reverberate between *The Origin of Species* and Victorian literature, as is Gillian Beer.² Although, like the palaeontologist, we wish to find the correct links between separate pieces of evidence, the character of the links for which we are seeking is fundamentally different. There actually was, at some point, physical evidence for the links between the organisms whose imprints constitute the fossil record, even though much of that evidence has been wiped out and now only exists in a fragmentary form, and in the species which persist today. The links in which we are interested, however, did not necessarily ever have this kind of physical incarnation.

Indeed, even false analogies can be very important for the literature/science critic. Whereas palaeontology will deal with the exposure of an incorrect classification of a fossil by adopting a new interpretation, and leaving the old one to a different discipline (history of science), a false analogy in our search for the bonds linking literature and science may persist in a more tenacious way. This is because we are concerned, first and foremost, with ideas about literature and science, and so a false analogy (which is, after all, an idea about something) continues to be of interest to other scholars. It is also because the distinction between true and false is perhaps less verifiable than in palaeontology, although this is not to deny that competing, contradictory systems of interpretation can co-exist in a scientific field. Most of all, though, it is because a misguided analogy can have significant material effects: a misconception about science, or about how literature and science are linked, can affect not only scholarship about literature and science but, if the misconception gains popular currency, the subject of that scholarship, literature itself. Popularisations, and hence translations, of science, in whatever form, can create distortions of the subject which are then manifested in literature.

For instance, since the mid-1980s chaos theory has become fairly prominent in the public consciousness and has been referred to, or invoked as a metaphor by, a number of works of literature - Tom Stoppard's play, *Arcadia*, provides a prime example, as do Michael Crichton's novel, *Jurassic Park*, and the Steven Spielberg film spin-off from the book, which also demonstrate that it has worked its way into popular culture.³ Once an idea has made this initial journey from professional science to

²N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca: Cornell UP, 1990). Gillian Beer, *Darwin's Plots* (London: Routledge and Kegan Paul, 1983).

³Tom Stoppard, *Arcadia* (London: Faber, 1993). Michael Crichton, *Jurassic Park* (London: Arrow, 1991). Both works use a fictional chaos theorist as a character in order to introduce the ideas associated

popular consciousness, its appearance in works of literature has a catalytic effect, fuelling its popularity and helping to create the public perception, the cultural value, of the concept. Yet there is no guarantee that these literary articulations of scientific ideas are based upon accurate translations of the raw material of the scientific concept, nor that the philosophical extrapolations, which are made from ideas like chaos theory, are in any way justified by the theory itself. When we consider that there is a whole body of other literature which does not include chaos theory explicitly, but which may be affected (either in the writing or the reading) by the cultural climate of which chaos theory is a part, then we can see how important a false analogy can be. Any move between literature and science must involve a translation from one language and system of interpretation to another, and in any translation there is an inevitable (and often productive) contortion of meaning.

The effect of translations between literature and science, and the distortions in meaning which result from them, can be more clearly imagined if we return to our analogy with palaeontology. A palaeontologist has access to a number of fossils which have to be accurately classified and placed into a relationship with one another based on their age and the species each fossil represents. The goal for the palaeontologist is the correct presentation of the relationship between the species represented by the fossils. In the process of coming to understand this relationship he or she may make a number of false analogies, misclassifying some fossils and wrongly representing their positions relative to each other. Crucially, however, the material evidence does not change as a result of the false theories that the palaeontologist postulates: each fossil remains the same.⁴ However a false theory, be it scholarly or popular (or, perhaps in an ideal world, both) about the relationship between literature and science, or about science itself, will actually result in a lot of new evidence in the form of books, films, newspaper and journal articles and so forth, which work on assumptions based on this false theory. This new evidence then becomes an important part of the field of study. It is almost as if lots of new fossils appear to fit into every new theory our hypothetical palaeontologist proposes.

If we are prepared to go a step further, as many scholars are (particularly, it ought to be noted, in the humanities, but also amongst contemporary historians and

with the theory directly to the audience - in *Arcadia* Valentine Coverly fulfils this role, and in *Jurassic Park* Ian Malcolm (played by Jeff Goldblum and relegated to a more minor role in the film) serves this function.

⁴Admittedly, this is an oversimplification: new fossils may be found which change the record and, if each new theory sees the fossils in a different way, then it might be argued that they are in some senses seeing 'new' fossils. Gould's *Wonderful Life*, referenced above and the subject of my seventh chapter, provides a convincing and lucid explanation for the process by which a scientist's world-view may control his/her interpretations and hypotheses. Nevertheless, books do not anchor our interpretations quite so firmly as fossils do the palaeontologist's, and so the effect is, as I am arguing here, appreciably more profound for the literature/science critic.

philosophers of science), and admit that science is itself culturally conditioned,⁵ then it becomes obvious that we cannot discard analogy in favour of pure homology. Homology may remain the goal of literature/science criticism, but any form in which it is articulated will have to take into account the influence of analogies upon the homology for which it strives, and concede that it is itself susceptible to the characteristics of analogy. Put more simply, what this means is that the truth will involve a correct account of the mistranslations and transformations of meaning that take place in the dialogue between literature and science, and an admission that, in the future, the 'truth' may itself be exposed as an incorrect analogy.

This is not, however, to endorse a position of complete relativism in relation to notions of truth and meaning. Whilst false analogies cannot be discounted, whilst they inevitably constitute a large proportion of the field of study, their importance does not mean that 'anything goes.' The project of this thesis is to represent as accurately as possible the relationship between contemporary (specifically postmodernist) literature and science. In this sense I am aiming for homology: an accurate picture of the interaction between literature and science in the last half of the twentieth century. Analogy will creep in as an inevitable part of this project on two levels however. Firstly, on that of the field of study, discussed above. The literature and popularisations of science with which this study is concerned inevitably deal with translations of various kinds (most obviously from primary scientific material), and hence with forms of analogy. Secondly, on the level of the thesis itself. Whilst it describes discourses which are fed from literary and scientific streams, it also draws from these discourses and in a small way (hopefully) feeds back into them.

So while this thesis inevitably aims for a metacritical level, for a viewpoint which is as objective and as accurate as possible, it would be naive to suggest that complete objectivity is a goal which can be reached. Utility therefore has to be the guiding principle: as it is impossible to be comprehensive, to account for every scientific concept and for every work of literature from every viewpoint, the objective is to produce a map which is as useful as possible in delineating the literature/science field by focusing on the key features of that field.

So, to summarise so far, we are faced with a problem which is very similar to that which faces the palaeontologist: how to distinguish genuine links between separate

⁵The most notable or notorious example (depending on your point of view) of this perception that science is shaped by the surrounding culture, comes from Paul Feyerabend. For instance, in commenting on the Copernican revolution, he suggests that the new ideas and observations could only be properly tested after a new world-view had been adopted by scientists: world-views do not follow the rational analysis of the evidence which justifies them, but rather create the conditions that allow for the new interpretations. Paul Feyerabend, *Against Method*, 3rd ed. (1975; London: Verso, 1993) 112. As will become apparent later on, I abstain from engaging in this debate, other than to note that it exists, so as to avoid commenting upon the truth of scientific claims, a subject about which I am not qualified to comment.

pieces of evidence from false links. Unlike the palaeontologist though, we are not dealing with a stable body of information. Whereas the palaeontologist can keep proposing theories until he or she finds one which explains the body of evidence as fully as possible, we are dealing with a field of study which is constantly in flux and which changes according to the attitudes that are taken towards it. However this does not mean that we can discard the notion and the ideal of truth altogether and, like the palaeontologist, we are aiming for a picture of the evidence before us which is as accurate as possible.

The analogy with palaeontology is also pertinent because we must employ a methodology which has inevitable similarities to that of the palaeontologist. We have to deal with fragments, small shards of a much larger picture, and from these fragments we have to reconstruct that larger picture. In other words, although we have access to various bits of information, the evidence for the links which tie them together does not necessarily exist, and so we must hypothesise about the connections that give them meaning. The palaeontologist has to do this because the fossil record is itself fragmentary, offering a few brief, accidental snapshots of what life was like in the past - snapshots of random animals that happened to die in situations resulting in a record of their passing. The vast majority of life passed without note however, and left no trace. We too have to deal with fragments but because of a surfeit, rather than a dearth, of information. The history of the interaction of literature and science, and the kaleidoscope of attitudes that constitute it, especially in recent years, is largely preserved in all the books, plays, poems, films, newspapers and other paraphernalia that make up our culture. This wealth of information is too great to be processed comprehensively. Like the palaeontologist, therefore, we must focus upon fragments, and from these postulate the larger picture. However, we do at least have the freedom to choose which fragments to concentrate upon, and so can at least focus our search on those areas which promise to be the most productive. I shall justify my choice of fragments - of novels, of science writing, and so forth - when I come to use them.

In order for us to understand how these fragments make sense as pertinent parts of a much larger culture, we need to be quite clear about what we mean by the term *culture*. I take my understanding of it from two sources: cultural anthropology and contemporary literature/science criticism. The former provides us with an explicit statement of what is really self-evident: culture is '*that complex whole which includes knowledge, belief, art, morals, laws, customs, and any other capabilities and habits acquired by man as a member of society.*'⁶ The latter qualifies this (Tyler wrote these words over a century ago) by offering a perspective on how culture manifests itself and

⁶Edward B. Tyler, quoted in John Friedl, *Cultural Anthropology* (New York: Harper's College Press, 1976) 41. Friedl's italics.

of what stuff this knowledge, belief, art, and so on is composed: culture is constituted by, and best understood as an amalgam of, various discourses. This is a widely held view and can be found, for example, in the introduction to *Languages of Nature: Critical Essays on Science and Literature*, in which L.J. Jordanova states quite explicitly that '[o]ur primary object of study is language - that which mediates all thought, action, experience. We focus largely on the discourses common to science and literature. . . .'⁷

This view of culture leads us to see literature and science acting as streams of discourse feeding into, and fed by, the rest of culture. Hence the interactions between literature and science with which I am dealing take place on a general cultural level. This is self-evident in the case of literature for it must always, by definition, be cultural. It is not so self-evident for science, however, because it still carries a strong association with truth and objectivity that makes the truths which it reveals appear universal, unbounded by temporal and geographical cultural boundaries. Whether this is or is not the case for pure science is a subject which is open to debate. On the one hand it is hard to argue against the notion that an equation like $E=mc^2$ is a truth which is universally valid, but on the other hand it is also hard to dispute that scientists work within world-views and preconceptions that are culturally conditioned, and which will insinuate their way into their work. There is certainly a more vigorous dialectic between notions of absolute truth and relativism than is apparent in the arts. However, what we can say with certainty is that science has a very definite cultural side to it, whether or not it also exists on another ethereal plane, apart from the influence of more local cultural trends. There are a whole series of cultural meanings attached to the term *science*, and to related terms, and these meanings inevitably get entangled with non-scientific discourses, like literature and art, in webs of mutual influence.

This cultural aspect of science manifests itself as a series of discourses flowing through the culture and it is with this cultural side that my thesis will engage. My interest is not, therefore, in science itself but in representations of science. Hence, when I deal with concepts like chaos theory, I will not be asking, what is chaos theory? but rather, how is chaos theory represented? This is an important distinction. By eschewing the first question I avoid getting caught up in arguments in which I am not qualified to engage. By asking the second question I engage with issues about science which deal with its role in the culture and, as a result, its interaction with literature. Therefore when I deal with popular representations of science, I do not pretend to comment upon science in all its technical depth and complexity, but I do claim that these popular representations allow us to understand the influence of science upon the culture

⁷L.J. Jordanova, introduction, *Languages of Nature: Critical Essays on Science and Literature*, ed. Jordanova (London: Free Association Books, 1988) 17.

as a whole. I will suggest that there is a large field of interactions between literature and science in the culture, and I shall offer a broad mapping of this field.

In order to gain access to it, and to come up with a formulation of the general literature/science model with which we can work, we must begin by turning our attention to the theoretical background which underlies current literature/science scholarship. In order to explain the history and development of this background, I shall invoke a concept which I call the *core literature/science discourse*. Although it sounds bombastic, this rather grandiloquent term is only used as a convenient shorthand with which to talk about the shared features of some key discourses.

The core discourse is not simply a text, nor a rigidly defined series of texts. Rather, it is constituted by all those texts which contribute to our understanding of the interactions of literature and science. Hence, it is comprised to a large degree by the literary critical work that has been done on literature and science in the past few years. However, it also includes all literary criticism which forms our understanding of literary history (but makes no specific mention of science), and popular representations of scientific ideas (which make no reference to literature), because these contribute to our understanding of 'literature' and 'science' before we bring the two together. The core discourse is therefore a general narrative which consists of all the individual, specific narratives that help to create our understanding of literature and science. It is this general narrative - somewhat vague and hard to specify, but nevertheless broad and influential - which I will turn to in section one (chapters one to four) of the thesis.

There are, in fact, three separate narrative strands involved in this core discourse: the history of literature, the history of science, and the history of literary criticism. Each of these follows a three-phase transition towards a postmodern incarnation. Literary critics (or at least those who have gone beyond the facile 'two cultures' notion)⁸ interweave these strands in different ways, according to their needs, but in each case the implicit or explicit story is composed of the same three narrative threads.

It is important to emphasise that there are a number of disagreements about where the key transitional phases in each narrative strand of the discourse occur and, although I shall point out the major areas of disagreement, I do not claim to account for every literature/science narrative, and do not claim that the discourse is wholly unified. However, by identifying the essential, core discourse, I will produce a working generalisation of the content of contemporary literature/science narratives.

⁸The phrase 'the two cultures' comes from C.P. Snow's 1959 Rede Lecture, in which he claimed a gulf of mutual misunderstanding had arisen between the Arts and the Sciences, and which led to a furious debate, principally between Snow and F.R. Leavis, about the relative merits and roles of science and literature in our culture. I examine this in more detail later on in this section of the thesis, where I discuss the origins of the science/literature split, and in the introduction to section two, where I discuss the consequences of the model of culture implied by the 'two cultures' notion.

It is also important to emphasise that there is another complicating factor, stemming from the intermingling of form and content in the literature/science discourse. The content of the core discourse culminates, as I shall show, in the three narrative strands - literature, science, and literary criticism - reaching their present, postmodern incarnations. Yet these postmodern incarnations themselves provide the justification for an approach which treats the three elements as dependent strands of a single discourse. The priority accorded to a view of truth as contingent not given, in postmodern discourses, and to a sense of literary and scientific discourses as constitutive, not merely descriptive, of the realities with which they engage, itself justifies the sort of approaches that have been made to literature and science in the last decade, and of which this thesis is one. In other words, postmodern ways of thinking about the culture have suggested that it is useful to think of it as a series of discourses, and it is these postmodern-specific ways of looking at the culture which enable this sort of discussion of postmodernity. This does not mean that an analysis of the history of literature and science is invalid, but it does show how it is historically specific, and how potent the dominant way of seeing the world can be in any given age.

These qualifications apart, the concept of the core literature/science discourse gives us a potent means of articulating the shift from modernity to postmodernity.⁹ This is not a shift which is universal, with all aspects of the culture now displaying postmodern characteristics, but is rather a shift in emphasis, the accent now being upon postmodern ways of thinking and articulating the discourses which constitute our culture. Modern discourses still exist of course, much as realist and modernist modes of literature still exist: they are still being written, and they still perhaps outnumber their postmodernist counterparts. Yet, postmodern discourses are becoming more influential and certainly exist in sufficient numbers to warrant a study of this type. Additionally, the growing importance of postmodernist narratives means that modernist ones are now more likely to be read through the lenses of postmodernity. So although the shift towards the postmodern is not absolute, it is nevertheless one which must be understood if we are fully to appreciate our own culture.

The most important aspect of this shift, for our purposes, is that in the concept of knowledge and, hence, in our understanding of how legitimisation takes place. Legitimation is an important issue because it drives to the very heart of how a subject knows itself, building the foundations upon which all debates in that subject take place, and justifying the statements that it makes.

⁹The suggestion that the culture has moved from modernity to postmodernity is, of course, still highly controversial. It will become apparent in the rest of my thesis that I am not making the claim that this is a universal shift. Instead, I am arguing that there are certain contemporary discourses that define themselves by virtue of their differences from the discourses associated with modernity. It is these discourses that I characterise as *postmodern*.

Section one of the thesis will therefore deal directly with knowledge, exploring the shift from Enlightenment legitimation strategies to postmodern ones. The introduction will sketch the distance between the two by contrasting the model of knowledge assumed by a key Enlightenment figure, René Descartes, with that implied by a key theorist of postmodernity, Jean-François Lyotard. Chapters one to four will then show how the core literature/science discourse constructs a history to explain the passage from the one to the other. Each of the first three chapters will deal with a different phase in the core literature/science discourse: the Enlightenment, the modernist crisis in Enlightenment legitimation strategies, and the eventual move to the post-Enlightenment with the advent of postmodern discourses in some areas of the culture. Chapter four will then reflect on how this history of the last three centuries is constructed through a process of canon formation. The second section of the thesis will use three case studies to illustrate the interactions between post-Enlightenment literature and science.

SECTION ONE

THE CORE

LITERATURE/SCIENCE

DISCOURSE

Introduction to Section One

Knowledge Then and Knowledge Now: From Descartes to Lyotard

I choose to focus on Descartes and Lyotard in the introduction to section one because each articulates a viewpoint on knowledge which is typical of the age in which he lived. They do not represent the only views on knowledge, but they are important anchors for any discussion about, respectively, the Enlightenment and the postmodern. Moreover, because each has written a single text which enunciates important perspectives on the status of knowledge in their respective epochs, we can use these texts to produce a direct comparison between the Enlightenment and the postmodern. René Descartes' *Discourse on Method*, first published in 1637, lays the basis for a method of approaching the world and acquiring knowledge which later evolved into the modern scientific method. Support for this view of the importance of the *Discourse* can be found in Albert Borgmann's *Crossing the Postmodern Divide*. He argues that the Cartesian method, combined with the influence of Francis Bacon's and John Locke's work, gave the Enlightenment its defining characteristics: 'We can think of modernism as the conjunction of Bacon's, Descartes's, and Locke's projects, as the fusion of the domination of nature with the primacy of method and the sovereignty of the individual. Again, the story so told is schematic and pointed, but it has exerted its power on the culture at large.'¹ I will focus on Descartes because his 'method' for approaching nature in order to gain knowledge is at the root of many Enlightenment epistemologies.

Just as Descartes provides a succinct outline of the Enlightenment approach to knowledge in *Discourse on Method*, so Jean-François Lyotard manages to do the same for postmodernity in *The Postmodern Condition: A Report on Knowledge*. Lyotard begins his introduction to the book by stating that '[t]he object of this study is the condition of knowledge in the most highly developed societies.'² Because Lyotard approaches the question of knowledge so directly, and because he consciously articulates a postmodern world-view, a comparison between Descartes' and Lyotard's views provides a contrast which is fruitful for our understanding of shifts in the conception of knowledge between the Enlightenment and the postmodern.

¹Albert Borgmann, *Crossing the Postmodern Divide* (Chicago: U of Chicago P, 1992) 25. Borgmann's use of the term *modernism*, here used to designate the *Enlightenment* or *modernity*, could be confusing. I will use it only to refer to the early twentieth-century movement in the arts we call *modernism*, and shall use *modernity* and *enlightenment* to denote the historical epoch.

²Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi, *Theory and History of Literature* 10 (1979; Manchester: Manchester UP, 1986) xxiii.

The basis for Descartes' view is, initially, a profound scepticism about the world which he inhabits. In the early part of the *Discourse* he renounces the certainty of received opinion as the basis for knowledge, and outlines how he intends to reject all elements of his knowledge whose certainty can in the least be doubted: 'as I wanted to concentrate solely on the search for truth, I thought I ought to . . . reject as being absolutely false everything in which I could suppose the slightest reason for doubt, in order to see if there did not remain after that anything in my belief which was entirely indubitable.'³

Yet this scepticism does not lead him to reject all possibility of constructing a stable body of knowledge. On the contrary, having swept aside all that is uncertain, he is then able to use what is left as the firm basis upon which to build a rational body of knowledge. The basis for this body of knowledge, the only element which remains 'entirely indubitable' for Descartes, is the certainty of his own identity, which he here formulates in a famous phrase:

while I decided thus to think that everything was false, it followed necessarily that I who thought thus must be something; and observing this truth: *I think, therefore I am*, was so certain and so evident that all the most extravagant suppositions of the sceptics were not capable of shaking it, I judged that I could accept it without scruple as the first principle of the philosophy I was seeking.⁴

So, after scepticism has eliminated everything else, this is the firm basis upon which knowledge must rest: a knowing, rational self. I want to argue that this is not only the 'first principle' for Descartes' philosophy, but also the first principle for many Enlightenment discourses. By positing a knowledge of the self which is certain, one can then postulate a body of valid knowledge which is arrived at by extrapolation from this first principle.

This is very different to the notion of the self which Lyotard proposes, and which is key to our understanding of postmodernity. It is worth quoting Lyotard at length here in order to draw out the contrast between his view and that of Descartes, between the postmodern and the Enlightenment:

A *self* does not amount to much, but no self is an island; each exists in a fabric of relations that is now more complex and mobile than ever before. Young or old, man or woman, rich or poor, a person is always located at 'nodal points' of specific communication circuits, however tiny these may be. Or better: one is always located at a post through

³René Descartes, 'Discourse on Method,' *Discourse on Method and Other Writings*, trans. F.E. Sutcliffe (Middlesex: Penguin, 1968) 53.

⁴Descartes 53-54.

which various kinds of messages pass. No one, not even the least privileged among us, is ever entirely powerless over the messages that traverse and position him at the post of sender, addressee, or referent.⁵

This erodes the certainty upon which Descartes' philosophy rests. For Descartes, the isolated but certain existence of the self guarantees a position of absolute truth upon which a body of knowledge can be built. For Lyotard however, the self is 'mobile,' and part of a communication network, a 'fabric of relations' which constitutes it. He admits that the self is not 'entirely powerless' over the messages which pass through it, but nevertheless claims that these messages 'position' the self. Selfhood here, therefore, is not the certainty of an isolated, rational knowing mind, but a buzz of messages to, from and through a 'nodal point.' With the autonomy of the knowing mind thus called into question, the notion of objective knowledge, which Descartes' philosophy supposes, is problematised.

If we return to Descartes we can see how the objective mind which he postulates leads to a definite, rational method of acquiring knowledge and hence to an objective body of knowledge. Crucially, Descartes' vision of the mind is one disconnected from the material world - the famous Cartesian duality in which the 'reasonable soul . . . could not in any way be derived from the power of matter.'⁶ Separated from the body, and standing outside all that is strictly material, the rational mind can look upon matters objectively.

Importantly, this reasonable mind is something which Descartes uses to define human identity, suggesting that it is this which distinguishes people from animals. He comments that the machinery of the body - bones, muscles, veins, and so forth - is much the same for men and for animals. Therefore, in order to understand what makes us unique, and what gives us our identity, we must look elsewhere - to the mind. By way of illustration he asks us to imagine two different attempts to render life artificially in the form of automata, one designed to be as like an animal as possible, and one designed to be as human as possible. He suggests that an automata which had the organs and appearance of a monkey, or of 'some other *irrational* animal' (emphasis added)⁷ would be indistinguishable from the real thing. However, a similar machine, constructed in the likeness of a man, would be easily distinguishable from a real man for two connected reasons. Firstly, although it may be constructed to respond verbally at the prompting of physical stimuli, it would not be able to respond to the sense of

⁵Lyotard 15.

⁶Descartes 76. The interaction of mind and matter is a difficult problem for Descartes, which he eventually solves by suggesting that the pineal gland is the medium through which thoughts have material consequences.

⁷Descartes 73.

anything that is said to it. More importantly, although it could be made to perform some tasks better than humans, it would fail in others which required it to act through knowledge. Automata are able to respond to particular, foreseeable circumstances, but only humans can respond to any eventuality, because 'reason is a universal instrument which can serve on any kind of occasion. . . .'⁸

Reason is the defining feature of humanity for Descartes, providing an absolute distinction from the material and natural worlds: reason separates soul/mind from body, and human from animal.⁹ It is important that this distinction is not a matter of degree but of absolute difference - Descartes is not just arguing that animals have less reason than humans, but that they have no reason at all. Human identity is therefore securely lodged in something very different to the 'communication networks' which Lyotard invokes. In chapter six I will show how the suggestion that reason and intelligence define a unique identity for humans is being broken down in the contemporary world by the increasing sophistication of electronic 'thinking' machines, and the complications these have produced in metaphors of humans as machines. William Gibson and Richard Dawkins, the writers on whom I focus, do not share Descartes' certainty that humans are intrinsically different to animals and machines.

Descartes' vision of a stable human identity wherein reason, as a human faculty which is separate from the material world, defines humanity, is the basis upon which he builds a four-point methodology for formulating an objective body of knowledge. The first rule which he proposes is to accept only as true that which is absolutely certain. The second is to divide problems into as many parts as possible. The third is to think through things in an orderly way, building from the simple to the complex. The last is to keep reviewing and checking his findings in order to be sure that nothing has been omitted.¹⁰ We will see how influential this methodology is when we come to look at the first phase of the core literature/science discourse, concentrating on Newtonian and other early Enlightenment science. The legitimacy of knowledge is guaranteed for Descartes, and indeed for many in the Enlightenment, by the application of this methodology.

⁸Descartes 74. It is interesting how this contrasts with recent science-fiction discourses about the difference between humans and androids. Reason distinguishes humans from animals and automata for Descartes, but contemporary narratives are happy to grant their automata immense intelligence. Instead, they are frequently let down by their inability to comprehend emotion.

⁹Thomas L. Hankins comments that, although reason was a 'rallying cry' during the Enlightenment, it had multiple meanings: 'order imposed on recalcitrant nature,' 'common sense,' or 'logically valid argument.' The last of these is that invoked by Descartes' use of the term. Thomas L. Hankins, *Science and the Enlightenment*, Cambridge History of Science (Cambridge: Cambridge UP, 1985) 2.

¹⁰Descartes 41. Significantly, Descartes derives this methodology from a science associated with certainty, geometry. Hankins comments that the Scientific Revolution, which affected all aspects of natural science in the second half of the eighteenth century, was limited initially to mathematics and astronomy. Hankins 2.

For Lyotard however, the method by which knowledge comes to be accepted as legitimate is very different. He distinguishes between two kinds of knowledge: scientific and narrative. Scientific knowledge demands legitimacy in much the same way that Descartes demands legitimacy: everything must be absolutely certain. However, narrative knowledge requires no such certainty and, because narratives define what can be said and done in the culture of which they are a part (because they formulate the social bond), they are legitimated simply because 'they do what they do.'¹¹

This would not mark a great progression from the notions of legitimacy proposed by Descartes, simply adding another separate kind of knowledge to the scientific, were it not for a further observation: scientific knowledge, though demanding legitimacy, is unable to legitimate itself except by recourse to narrative knowledge. Asked to justify itself - and science's demand for legitimacy means that it must justify its existence - science can only spin a narrative which sets up humanity (specifically, science-dependent humanity) as a hero of knowledge or a hero of liberty.¹² In other words science can only justify itself by spinning vague narratives about progress towards absolute knowledge, or about science conferring freedom. The questioning of the teleological imperative, that Lyotard formulates here in relation to science, is something I pick up on in my seventh chapter, which deals with the work of Stephen Jay Gould and Kurt Vonnegut, Jr.

Interestingly, Lyotard's critique of science can be applied directly to the *Discourse on Method*. It probably draws most heavily on the narrative that constructs the scientist - in Descartes' case, the reasonable man - as a 'hero of knowledge.'¹³ Lyotard comments that this particular narrative requires the unification of two sets of discourse: one to do with truth and the other to do with justice ('ethical, social, and political practice').¹⁴ Somehow the true and the just are meant to coincide, and this synthesis will confer legitimacy. It is a synthesis which takes place through the fulfilment of a three-fold aspiration - each part of which we can find in Descartes' work. Firstly, everything must be derived from an original principle corresponding to scientific activity (Descartes' four rules). Secondly, everything must be related to an ideal governing ethical and social practice (the ordered, comprehensible world that Descartes presupposes). Finally, these two must be united in a single idea, whereby the pursuit of the true and the just coincide. This crucial unification is achieved in the

¹¹Lyotard 23.

¹²See especially, chapter nine of Lyotard, 'Narratives of the Legitimation of Knowledge' 31-37.

¹³Lyotard 31.

¹⁴Lyotard 32.

Discourse because Descartes presupposes a divinely created world in which a supernatural being guarantees that the true and the just are one and the same: 'reason does not dictate that what we see or imagine thus is true, but it does tell us that all our ideas and notions must have some basis in truth, for it would not be possible that God, who is all perfect and true, should have put them in us unless it were so.'¹⁵

So Lyotard's rejection of the traditional notion that science confers legitimacy can be used to expose the dependence of Descartes' position upon certain rhetorical structures. The primacy of science is rejected by Lyotard because it is dependent upon narrative knowledge - a form of knowledge which it claims to be inferior. Indeed, the age of the grand or meta narratives (narratives, like science, which claim to explain all other narratives) is gone: 'The grand narrative has lost its credibility.'¹⁶ He offers two visions by which legitimization might proceed in the future. The first is by performativity, wherein the criteria of efficiency (and hence presumably of the market) predominate, and the second is by paralogy, in which a multitude of *petit récits* ('little narratives') compete not to produce overall consensus, but to produce agreement on a local scale about what constitutes the true. Lyotard strongly favours the second of these, which he idealistically envisions as having the power to overcome the tyranny of universal world-views (by accepting the provisional nature of all knowledge). The first, on the other hand, may create a frightening scenario in which a wealth/efficiency/truth equation comes to assume extreme potency.¹⁷

So Descartes and Lyotard offer radically different notions of how legitimacy should be conferred: Descartes suggests that it comes from the application of a universal, rational method, and Lyotard claims that it is dependent upon local agreement. These different approaches inevitably lead to radically different ideals for the knowledge systems underlying Enlightenment and postmodern narratives. Beneath the first is the belief that we can reach a universally accepted criterion of truth. The ultimate ideal for such a method is the apprehension of all knowledge, and Descartes conforms to this, arguing that there is nothing that cannot be known by the application of rational principles:

These long chains of reasonings, quite simple and easy, which geometers are accustomed to using to teach their most difficult demonstrations, had given me cause to imagine that everything which

¹⁵Descartes 60.

¹⁶Lyotard 37.

¹⁷Lyotard 44-45. Interestingly, these two ways by which legitimization might proceed feature prominently in discourses about the Internet, where there is a conflict between the desire for it to become a means for people to develop and contest their own 'little narratives,' and the fear that it will become just one more mechanism by which the free-market asserts its control.

can be encompassed by man's knowledge is linked in the same way, and that, provided only that one abstains from accepting any for true which is not true, and that one always keeps the right order for one thing to be deduced from that which precedes it, there can be nothing so distant that one does not reach it eventually, or so hidden that one cannot discover it.¹⁸

We shall see, when we come to look at the first phase of the core literature/science discourse in chapter one, how this ideal, and this belief that all knowledge can ultimately be obtained, becomes prominent in Enlightenment science. In particular, a famous and oft-quoted statement by Pierre Simon de Laplace, which I discuss on page twenty-five, echoes Descartes' belief that everything can theoretically be known. This ideal is based upon a specific teleology, as the last two phrases of the previous quotation illustrate: progress towards a state of absolute knowledge.

This is not an ideal that can be retained in the postmodern age, at least not if we follow Lyotard's lines of reasoning. Because what comes to be accepted as true - what constitutes knowledge - is the result of negotiation, and because we cannot claim to be able to construct a wholly objective body of knowledge which will remain true into the infinite future, we cannot hope to construct any body of knowledge that can be absolutely legitimated. We shall see how this works its way into presentations of contemporary science later on in the thesis.¹⁹ In particular, the upsetting of the order/disorder distinction that I discuss in chapter five, and which is apparent in certain presentations of chaos theory (and also, as I shall show, in Thomas Pynchon's novels), implies that there are fundamental theoretical limits to human knowledge.

So, to summarise, both Descartes' *Discourse on Method* and Lyotard's *The Postmodern Condition* articulate an approach to knowledge which is typical of the epochs in which they are produced. The *Discourse* is a work which encapsulates the essential features of the Enlightenment view of knowledge: it exists in a stable, knowable sense and can be apprehended by a rational being who looks on from a position of objectivity. *The Postmodern Condition* marks a significant contemporary alternative to this viewpoint: knowledge does not exist in an objective sense, it can never be wholly legitimated, and is the product of negotiation between interested parties.

In positing a view of knowledge, both works also postulate a hypothetical subject who knows that knowledge. In the *Discourse* this subject is a rational being,

¹⁸Descartes 41. It should be noted that the proviso in the phrase 'everything which can be encompassed by man's knowledge,' expresses humility in the face of a divine being which is appropriate to a religious age.

¹⁹Lyotard himself refers to some contemporary science as 'postmodern' in chapter thirteen of *The Postmodern Condition*. Lyotard, 'Postmodern Science as the Search for Instabilities' 53-60.

isolated from that which it observes, and in *The Postmodern Condition* it is a point in an information network, criss-crossed by information, messages and discourses - in a real sense then, a participating agent in the world which it seeks to know.

Having formulated these essential differences between the Enlightenment and the postmodern, we can now go on to see how the core literature/science discourse enacts the evolution from the former to the latter, in each of its narrative strands: literature, science, and literary theory. In all three there is the construction of a parallel three-phase historical development. I will go through each of these phases in turn, drawing out the links between the science, the literature, and the literary theory, in chapters one, two and three.

Chapter One

The First Phase of the Core Literature/Science Discourse: Newtonian Science / Realism / New Criticism

The first phase of the core literature/science discourse is one in which each of its narrative strands is determined by a view of knowledge and legitimation which is roughly equivalent to that found in Descartes' *Discourse on Method*. This does not mean that Descartes' views about the universe, or about what we call physics, are accepted unequivocally throughout the Enlightenment. Indeed, many of his specific observations are quite explicitly refuted, and the empiricism of John Locke, George Berkeley and David Hume is probably more directly important to the scientific enterprise than his rationalism is. However, Descartes' importance lies in the philosophical enquiries, and the investigations of nature, that his new, modern philosophy made possible - he opened up the way for many who came after him. As F.E. Sutcliffe argues, in his introduction to the *Discourse on Method*, 'the profound significance of Cartesianism is precisely to give such a definition of the object of physics as to found the possibility of a science of laws reached through experiment.'¹ Certain general principles of methodology, and assumptions about how the universe behaves, are shared between Descartes and other early Enlightenment approaches to the world, and these form the basis of later beliefs, methodologies and ideals. This is most obviously the case with the scientific strand of the discourse, and so it is to this that I will first turn my attention.

Newtonian Science

The subject of this element of the discourse goes under a number of possible labels: classical, Enlightenment, Newtonian, or early modern. It is that science initiated by the success of Newtonian physics in the seventeenth century, and the influential ideas which followed from it about what the universe is and how it can best be understood.

Isaac Newton himself is important to our understanding of these early developments, not only because of his discoveries, but also because he came to function as a potent symbol of the new Enlightenment. Thomas Hankins comments that at the time he appealed to Frenchmen like Voltaire and Montesquieu because he came from England, then associated with freedom of thought and liberty, and because his chief achievement - to show that the movements of the planets obeyed the same rules as motions on earth - was of such far-reaching significance. As a result there was no

¹F.E. Sutcliffe, introduction, *Discourse on Method and Other Writings* (referenced above) 22.

'comparable hero,' and he seemed to give the lead to others who would aspire to unveil nature's secrets: 'The obvious way for natural philosophy to progress was for natural philosophers to complete Newton's program of research, using his methods. The science of the Enlightenment would then be "Newtonian," and its philosophy would be one of "Newtonianism."'² Hankins disputes whether it was actually quite so straightforward to simply follow Newton's lines of enquiry in order to get results, but he does acknowledge his symbolic importance to the Enlightenment: 'On the popular level it [*Newtonian*] stands for something, and in the ideology of the Enlightenment it stands for a great deal, but when taken to the laboratory and to the mathematician's desk it is too general and imprecise to be of much help to the historian of science.'³ It is because the term *Newtonian* is so resonant on a popular level that I choose to use it, above the other possible labels, to stand at the head of this chapter.

Not only did Newtonian science demonstrate a congruity between the cosmos and the earth, its success also served to open up a split which was later to develop into the institutional differences between the Sciences and the Arts. In order to understand this we need to be aware that there were, broadly speaking, three means by which truths about God could be known in the Middle Ages: the revelation of scripture, the application of pure reason, and natural theology. With the dawn of the scientific age, the last of these - which involved searching for laws and regularities in nature so as to reveal the divine order underwriting it - became much more important: 'As the achievements of science grew in the seventeenth century, the argument from design [a key aspect of natural theology] began to replace a priori rational arguments and often even the Revelation of Scripture as the principal evidence for religion.'⁴ The success of Newton, and those who followed him, demonstrated the promise of a path to knowledge that rejected literary criticism (analysis of the bible and other sacred texts) and replaced it with natural philosophy (what we would term science): 'If God could be known from his creation, the Bible was not necessary to prove the existence of God.'⁵ In the last sub-section of this chapter, in which I discuss I.A. Richards, we will see how profound this split between the Arts and the Sciences had become by the twentieth century.

Coming back to the natural philosophy of the Enlightenment, study of the core literature/science discourse reveals two entwined groups of presuppositions that are buried in this early phase of scientific development. The first are fundamental beliefs

²Hankins 9.

³Hankins 10.

⁴Hankins 3.

⁵Hankins 3.

about what nature is (how it is structured and how different parts of it interact), and the second are assumptions about methodology (how we know the universe). These two categories of beliefs are mutually reinforcing because ideas about what the universe is dictate the methodology that it used to analyse it, and the application of this methodology almost inevitably reveals the universe to be, in its general characteristics, as we think it is.⁶

I will focus initially upon the methodology because it assumes, for most practical purposes, the existence of a Cartesian duality. By starting with this I will be able to show how Descartes' ideas are important to Newtonian science. His separation of body and mind allows him to postulate the mind as an objective, rational entity that can shake free of the encumbrances and delusions which affect our senses, as we have seen (it is important to note that other Enlightenment philosophers - notably Locke - were not so convinced that we could acquire absolutely certain knowledge).

This means that the observer is separated from the world which he or she studies, and is therefore able to approach it objectively, without prejudice, and without in any way affecting the results of the observations that are made. It is at this point, perhaps, that we have to admit the small variance between the scientific method and Descartes' philosophy. Descartes believed that rational enquiry alone was sufficient for us to build up a substantial body of truths. The scientific tradition, as it eventually developed, went one step further by combining the rational Cartesian methodology with experimentation (which perhaps drew more from the empiricist conviction that all knowledge comes from our senses).⁷ Descartes suggested that rational enquiry alone was sufficient; science, as it eventually developed, applied this rational enquiry to evidence revealed by systematic observations of nature. Descartes is important, and I have focused upon him, because he trumpets the possibility that the rational mind, separated from the body, is able to hold an objective corpus of knowledge about the external world. Although the empiricists admitted that our knowledge of the world is always probable, rather than absolutely established, in essence they underwrote the possibility of objectivity by an appeal to common sense.

⁶See Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed., International Encyclopedia of Unified Science 2.2 (1962; Chicago: U of Chicago P, 1970). This represents a famous articulation of the argument that our enquiries into nature are limited by the world-views within which we work, claiming that conceptual revolutions are necessary before scientific change can take place. However, one has to be careful not to push it too far. Scientific discovery obviously does do more than unveil what we already suspect (in fact, this is perhaps Kuhn's point) - otherwise there would never be innovation in our understanding of the universe. The point is that in a very general sense we work within presuppositions about nature and that these dictate the kinds of enquiries we are likely to undertake - however, the dialogue that takes place between nature and our research into it does allow for change.

⁷In philosophy, empiricism and rationalism are directly opposed. However, it is not unreasonable to suggest that there was an element of 'mix and match' between the two in the early development of science. John Locke, a key empiricist, was heavily influenced by Descartes.

We can see an example of this view of Newtonian science in an essay by Adalaide Morris about the poetry of H.D. Morris comments on the similarities between H.D.'s poetry and the science (botany and astronomy) practised by her relations, and argues that her early poetry conforms with the assumptions of Newtonian science, whereas her later poetry reacts against these preconceptions. What lies at the heart of both H.D.'s early poetry, and botany and astronomy, is 'an assumption so fundamental as to seem self-evident: the belief that there is a "real" world separate from the observer, a world we can assess without in any way altering.'⁸

This separation between observer and observed enables the foundation of a body of rational, testable observations about the universe, which can be built upon in order to create an expanding body of scientific knowledge. The rational onlooker can make objective hypotheses about the rules that generate the phenomena he or she observes because of his/her separation from the outside world. These hypotheses can then be ratified by other rational minds, and tested through experiment and further observation.

This is entirely congruous with the first and fourth of Descartes' four rules, that I discussed in the introduction to section one, about accepting only as true that which is absolutely certain (rule one) and constantly checking on findings (rule two). The first rule depends upon the ability of the observer to make objective judgements about what is right and wrong, and the second allows others (the scientific community) to check and build upon these findings, because they are also rational observers. It is not difficult to see how this leads to the popular version of scientific progress as a steady accumulation of knowledge.

We can see how Descartes' other rules, about dividing problems into as many parts as possible (rule two) and building from the simple to the complex (rule three), are also important by turning our attention away from the methodology of Newtonian science to its basic assumptions about what the universe is. Perhaps the most fundamental of these assumptions is atomism: the belief that reality is comprised of a multitude of separate phenomena which, although they may interact with each other, can best be understood in isolation. In a book which explores the passing of this paradigm, *The Cosmic Web*, Katherine Hayles provides a neat summary of it, claiming that 'the Newtonian idea of reality [was one] in which physical objects are discrete and events are capable of occurring independently of one another and the observer.'⁹ Because

⁸Adalaide Morris, 'Science and the Mythopoeic Mind: The Case of H.D.,' *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles (Chicago: U of Chicago P, 1991) 203.

⁹N. Katherine Hayles, *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* (Ithaca: Cornell UP, 1984) 9-10. Hayles's thesis is that we have shifted from the Newtonian perception of reality to a 'field' view where things are intricately linked, and where matter and energy seem to be interchangeable. This shift accords with the change from the Enlightenment to

phenomena are discrete, it follows that they can be understood independently of one another, and a vision of reality as a whole can be constructed from a simple accumulation of separate observations: the whole is exactly the sum of the parts.

Again, there is a resonance here between a view of reality and the methodology which is used to investigate it. Once the atomistic view is taken as a given, the way to understand problems is, inevitably, to break them down to their individual, constituent parts (Descartes' second rule), deal with each separately, and then reassemble the parts again in order to yield an understanding of the whole (building from the simple to the complex as Descartes' third rule implores us to do). This atomistic view and methodology also helps to explain the rigid separation of institutional science into various disciplines (physics, chemistry, biology) and sub-disciplines. Interestingly, it is sometimes claimed that chaos theory, which I identify with a shift to the third phase of the literature/science discourse in chapter three, was enabled by scientists willing to break down and transcend rigid disciplinary boundaries.¹⁰

So, we have a view of the universe as a whole which is constructed of lots of discrete, individual parts. These parts are generally perceived to react with each other, in the Newtonian paradigm, in a linear fashion. What this means is that cause and effect are broadly aligned. As Paul Davies and John Gribbin put it, 'a linear system is, simply speaking, one in which the whole is equal to the sum of its parts (no more; no less), and in which the sum of a collection of causes produces a corresponding sum of effects.'¹¹ This means that, complex though the universe is, there is a basic, understandable simplicity underwriting individual interactions between its constituent parts. By building from small to large problems we can therefore come to understand the complexity of the universe.

The Newtonian vision of the universe is basically, then, one of a large, clockwork mechanism. This has some important consequences. If the universe is a machine, then what happens within it is completely determined by the rules governing that machine. If we know those rules - if we can discover the laws of physics - then we can predict what will happen in the future. This is forcefully brought home by an oft-quoted remark of the French eighteenth-century mathematician, astronomer, and philosopher of science, Pierre Simon, Marquis de Laplace:

the postmodern that I have identified in this thesis - the 'field' view would represent what I call a third-phase discourse.

¹⁰See James Gleick, *Chaos: Making a New Science* (1987; Middlesex: Penguin, 1988). This point is made emphatically in Gleick's book.

¹¹Paul Davies and John Gribbin, *The Matter Myth: Beyond Chaos and Complexity* (1991; London: Penguin, 1992) 38.

Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it - an intelligence sufficiently vast to submit these data to analysis - it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes.¹²

This quotation neatly encapsulates the project and philosophical assumptions of Enlightenment science: given enough information, everything can be known. It is remarkably similar to the ideal which Descartes proposes for his methodology, quoted on pages seventeen and eighteen. For him, there is 'nothing . . . so hidden that one cannot discover it,' and for Laplace, 'nothing would be uncertain' to an intellect of sufficient size. Although there is a difference between the two formulations - Descartes suggests that reason alone will give us knowledge, whereas Laplace sees the need for reason to act upon information - they are bonded by an assumption that absolute knowledge can be acquired.

Because Laplace seems to capture the spirit of Enlightenment science so well, he features as a prominent figure in the core literature/science discourse, and is often explicitly linked with Newton in order to make his centrality to that discourse apparent. For instance, Morris refers us to a book by Jeremy Bernstein that will give us 'a brief summary of Newton's equations and the Marquis Pierre Laplace's formulation of their deterministic consequences';¹³ Stephen Toulmin comments that 'the intellectual ideal of Science which Laplace had inherited from Descartes and Newton was captured in the image of an Omniscient Calculator';¹⁴ Stephen Hawking links Newton and Laplace, before talking of a 'doctrine of scientific determinism';¹⁵ and Hayles goes from Newton's theories of motion in one sentence ('it was in theory enough to know the initial set of conditions and Newton's laws of motion to predict any future state [of a system], assuming only sufficient intellect . . . to do the calculations') to a reference to Laplace in the next (the 'great French mathematician Pierre Laplace imagined [such an intellect]').¹⁶

¹²Pierre Simon Laplace, *A Philosophical Essay on Probabilities*, trans. Frederick Wilson Truscott and Frederick Lincoln Emory, 6th ed. (1819; New York: Dover, 1951) 4.

¹³Morris 218.

¹⁴Stephen Toulmin, *The Return to Cosmology: Postmodern Science and the Theology of Nature* (Berkeley: U of California P, 1982) 243.

¹⁵Stephen Hawking, *A Brief History of Time: From the Big Bang to Black Holes* (London: Bantam, 1988) 53.

¹⁶Hayles, *Cosmic Web* 42.

What is important to note about Laplace's account of determinism is that it is linked to the idea of predictability. In later stages of the discourse this link will be severed. For instance, chaos theory does not reject the idea that things are determined, but it does deny that they are predictable. Similarly, I will show in chapter six how the boundary between machines and humans is transgressed in many contemporary discourses, and how this results in machines (traditionally seen as determined and predictable) being endowed with some of the qualities of living things (unpredictability and even free will).

This does not, of course, mean that Enlightenment scientists necessarily thought that it actually would, in future, be possible to predict everything that would happen in the universe. Nevertheless, the basic faith underpinning the Newtonian paradigm was that this complete knowledge was theoretically possible. Although Laplace's 'Omniscient Calculator' was not a reality, it was an idealisation that reveals a central Enlightenment truth: the only handicap to our knowledge is lack of information and lack of processing power.

The consequence of this for legitimisation is that it almost ceases to be an issue at all. This is for two reasons: the language (the scientific and mathematical tools) we use to articulate reality can present it without distortion; and reality itself is assumed, for all practical purposes, to be unproblematically 'there.' We will find the second phase of the literature/science discourse disputing the former of these assumptions, and the third phase disputing the latter.

What all this comes down to is that, although knowledge does have to be legitimated in this phase of the discourse, the criteria by which that legitimisation is guaranteed are never in doubt. The content of scientific narratives might well be questioned, but the basic form of those narratives is not open to debate. We can see these assumptions about reality - and therefore about legitimisation - also manifesting themselves in the literary strand of this phase of the discourse.

Realist Literature

The literary strand of this phase of the discourse is determined by similar assumptions, and might, broadly speaking, be termed *realism*. It is characterised most typically by the nineteenth-century novel, with prior novels situated in a history of ever-increasing technical sophistication, evolving towards this ultimate embodiment of the realist style. Of course, there are many ways in which a novel can be realistic, but the emphasis here is on an accurate picture of social reality, protagonists whose actions coherently express their characters, and narrators who can be trusted to tell the truth as they guide us deftly through the plots that constitute their stories.

More important than the content of the novels, for the literature/science discourse, are the forms in which that content is presented, and the unspoken pact that they establish between reader and writer. Realist novels come to us in forms which seek in many ways to hide themselves, to render their constructedness invisible, and to communicate the story to the reader without asking him or her to question how an understanding of the story is prejudiced by the form in which it is presented. Hence, omniscient or reliable first-person narrators tend to be favoured, and a pact is tacitly established between author and reader: however complex, however open to interpretation the story may be, there is a basic level of truth within it, a fundamental 'reality effect' produced by the novel, which will not be punctured.

This can be seen in Mary Shelley's 1818 novel, *Frankenstein*, which is of obvious importance to the literature/science discourse. Although it indulges fantastic and gothic modes to the full, and in so many ways obviously does not belong to the real world, both the realist style, and its corollary, the pact between author and reader described above, remain intact. The employment of epistolary techniques assures the reader that he or she is dealing with 'real' documents, a faithful transcription of Walton's correspondence to his sister. Victor Frankenstein's fantastic narrative is conveyed only within the bounds of these trustworthy documents, and the monster's even more outrageous story is further embedded and mediated by these two faithful reproductions. While there are opposing viewpoints, questions about the reality presented by the novel, that are not resolved - for instance, Frankenstein's view of the monster as an 'abhorred devil' who must be destroyed, and the monster's counter-claim that he is owed the duty that creator owes to created¹⁷ - there is no sense in which the actual existence of the novel's reality is interrogated.

Of course, this is all part of a game played by every realist novel, and the reader is fully aware that the novel is not real, that the correlation between fiction and reality is illusory. Although this is accepted, it is not pursued any further, as though neither opponent can be bothered to play out the game's predictable sequence of events towards the inevitable result. Instead, the reader suspends disbelief - might even complain that the novel is not real enough - and the author presents the fictional world of the novel as realistically as possible.

An objection to this version of literary history might be raised by reference to those eighteenth-century novels which employ metafictional techniques - like, for instance, direct authorial interjection - to undermine the developing novel genre. However, novels like those of Denis Diderot and Henry Fielding, which engage in the game by puncturing and satirising eighteenth-century novel-writing conventions, adhere to a fundamental level of reality which is not called into question. As Susan Strehle

¹⁷Mary Shelley, *Frankenstein: Or, The Modern Prometheus* (1818; London: Penguin, 1985) 146-47.

suggests, Fielding remains an authorial 'Presence'¹⁸ in his novels in a way which is completely different to the 'presence' of a postmodernist writer like John Barth, and this maintains a basic reality-effect. Strehle's capitalisation of 'Presence' is important - there is a stable authorial voice in *Joseph Andrews*, albeit one which satirises itself and its contemporaries. The effect is to interrogate writing and reading practices of the eighteenth century, whereas the effect of twentieth-century postmodernist writing and metafiction is to interrogate, not only our expectations as twentieth-century readers, but also the reality that we inhabit, and the way our perceptions of it actually help to constitute it. So, although metafiction of the realist age draws the reader into a game with the author, it is a game where the stakes are low and the domination of the author is never in doubt.

Realism, then, presents a vision of reality where legitimisation is not an issue. Narratives do not have to legitimate themselves as they are taken on trust. This is, perhaps, not so much a vision of reality, as an unspoken assumption, a faith that reality is there and that the narratives that are used to present it are wholly sufficient to their task. It is in this respect that there is a congruity between realism and classical science. Reality is assumed to be a commonsensical phenomenon which can be taken for granted, and which can be presented perfectly adequately by appropriately deployed literary forms.

The emphasis in literature in this phase of the discourse, particularly in the novel, is on an ordered, straightforward style. The nineteenth-century novel, the apotheosis of realism, expresses a vision of an ordered, understandable universe which is equivalent to that proposed in science. Chaos does of course exist, and is represented as a potent threat to order (this is the monster's function in Shelley's novel), but it does not, in general, work its way into literary forms. In fact, the strict division between order and disorder, with a privileging of the former over the latter, is characteristic of this phase of the discourse.

Neither does science ignore disorder altogether in this phase of the discourse. For instance, the mathematics of probabilities provides a means of describing and assimilating the random, that which is otherwise beyond rational explanation. However, science's project, as I indicated earlier, is obviously to find the underlying order, the laws, which govern the universe, and so tame chaos.

What we will find in later phases of the discourse is a challenge to this strict binary division between order and disorder. For instance, later literature begins to promote chaos by embracing less-ordered forms, acknowledging a less-ordered

¹⁸Susan Strehle, *Fiction in the Quantum Universe* (Chapel Hill: Carolina UP, 1992) 152.

universe, and eventually aligning itself with the exploration of a middle ground between order and disorder, similar to that investigated by chaos theory.¹⁹

It is partly in response to a perceived threat of chaos that I.A. Richards, to whom I turn now for my analysis of early literary theory, formulates his ideas. The chaos which he worries about primarily is that which he sees as threatening to engulf society at the beginning of the twentieth century. By making a definite stand on issues to do with culture, he sees it as possible to guard against this threat of disorder. As we shall see, order and disorder are important concepts for an understanding of his work.

New Criticism

The literary-theoretical strand of the discourse, existing in a relationship of mutual reinforcement with the scientific and literary strands, is best encapsulated in New Criticism, and I shall concentrate on the work of one critic, I.A. Richards, in order to demonstrate this. It will be noticed that this strand appears to be dramatically unsynchronised with its scientific and literary counterparts. I have talked so far about Newtonian science, developing in the seventeenth and eighteenth centuries, and the novel, developing at a similar time. How, then, can I account for a parallel discourse appearing in literary criticism in the twentieth century? A number of points need to be made.

Firstly, although the scientific and literary strands of the discourse have their beginnings three centuries earlier, they do not move into the second phase of the literature/science discourse until the early twentieth century. As a result it is not unreasonable to argue that literary theory can partake of the same discourse at this time. Secondly, although literary theory has its roots much earlier in history, it is only with the institutionalising of literature in the universities at the beginning of the twentieth century, that there is any attempt to formalise its study. Because Richards is one of the first to do this it makes more sense to focus on his work, which explicitly states why and how we should study literature, than to attempt a survey of earlier literary criticism. Finally, as I shall make clear in chapter four, the core literature/science discourse is a particular version of history, created by the processes of canon-formation at work in our society. Because of this, there is a tendency to look back from the present, seeking the elements that have led to the present state of literature, science and literary theory. It is therefore possible to consider earlier forms of all three narrative strands as equivalent, even if there is not an exact chronological tie between them.

¹⁹Although it will become apparent in my later discussions, it is important to note at this point that chaos theory does not involve a renunciation of the attempt to describe the universe, but rather an acknowledgement of the limits of our descriptions.

Richards' work resonates with the literature and science which I have discussed in this chapter because it is not overtly theoretical. Its implicit claim is that it enunciates the natural way to read and perform criticism, and so it forestalls questions about legitimation just as the other two strands of the discourse do. Although Richards sometimes uses the term *theory* to describe his work, it is not meant in the sense of 'hypothetical postulation about how we read,' so much as 'statement about how literature and literary criticism work.'

In order to expose the assumptions which underpin his ideas, particularly in relation to notions of order and disorder, I shall draw on evidence from Richards' three main books: *Principles of Literary Criticism* (1924), *Science and Poetry* (1926), and *Practical Criticism: A Study of Literary Judgment* (1929). I will proceed by asking three sets of questions about his work, the first to do with his definitions of crucial terms, the second to do with the effect of literature upon society, and the third to do with how we should read literature.

The first set of questions is this: what is an individual (reader)? and what is literature? Because the definition of literature that Richards supposes is bound up with its relationship to science, I shall also ask, where do science and literature fit into the culture?

The idea of the individual (specifically, of the individual mind) that he proposes, is in debt to two sources: an Enlightenment conception of the mind, similar to that proposed by Descartes, and contemporary work in psychology. Like Descartes, he configures the human mind as being essentially ordered and capable of rational, objective judgements about the world. Just as Descartes suggests that the mind can improve its knowledge by building step by step from simple, definite principles to more complex truths, so Richards suggests that there is a tendency towards increased order in the mind.

The difference between the two lies in the fact that, whereas for Descartes the mind was an essentially static medium for processing and accumulating information, for Richards it is more dynamic: the mind has a tendency to change, to become more ordered, and to improve. Human development, as it is presented in *Principles of Literary Criticism*, is a process of progressive systematisation of the mind itself: 'At every stage in the astonishing metamorphosis [from child to adult], the impulses, desires, and propensities of the individual take on a new form, or, it may be, a further degree of systematization.'²⁰ Similarly, this tendency towards increased order is brought out in *Science and Poetry* when Richards tells us that, 'we should picture the

²⁰I.A. Richards, *Principles of Literary Criticism*, 2nd ed. (1924; London: Routledge, 1967) 34.

mind as a system of very delicately poised balances, a system which so long as we are in health is constantly *growing*.’²¹

So both Richards and Descartes share a compatible, though not an identical, vision of the human intellect as an ordered entity. However, Richards adds another very important element to this model which comes out in the phrase ‘system of interests’ in the following quotation:

It may seem odd that we do not more definitely make the thoughts the rulers and causes of the rest of the response. . . . Man prefers to stress the features which distinguish him from monkey [sic], and chief among these are his intellectual capacities. . . . [But] though his intellect is what is distinctive in man, he is not primarily an intelligence; he is a system of interests. Intelligence helps man but does not run him.²²

Man’s ‘thoughts’ and ‘intellectual capacities’ were what Descartes was interested in. Like Descartes, Richards cites these as the elements which mark out humanity as distinct from the rest of the animal kingdom (‘the features which distinguish him from monkey [sic]’).

However, he departs from this tradition by contrasting intellect with what he here calls a ‘system of interests.’ These might be thought of as equating, very roughly, with emotions, or feelings. This sharp distinction between intellect and emotion is what gives literary theory, in this first stage of the literature/science discourse, its defining characteristics. Science had become the province of the rational intellect and methodology proposed by Descartes. As we saw earlier on in the chapter, Newtonian science took up the methods and aspirations found in the *Discourse on Method*, and applied them with great success within its field of study.

The implication of this success for literary theory was that it needed to carve out its own territory (in terms of subject matter), away from the influence of science, because it could not compete with it. This is where Richards’ distinction between the intellectual and emotional sides of the human mind comes in. By configuring science as the terrain of the intellect (the rational mind proposed by Descartes), and then drawing on redefinitions of the mind which see it as a ‘system of interests,’ as well as an intellect, Richards is able to define a province that is beyond the reach of science. At least, it is beyond the reach of science for the foreseeable future: ‘If we knew enough it might be possible that all necessary attitudes [of the mind] could be obtained through

²¹I.A. Richards, *Poetries and Sciences: A Reissue of Science and Poetry (1926, 1935) with Commentary*, rev. ed. (1926; London: Routledge, 1970) 25.

²²Richards, *Principles* 30.

scientific references alone. Since we do not know very much yet, we can leave this remote possibility, once recognized, alone.’²³

This means that the life of the mind cannot be accessed by science. This is where literature comes into the picture as a means of organising the individual’s mind (which I will return to later), and as an expression of all that is beyond the reach of scientific description. Just as the rational side of the mind is associated with the verifiable truths of science, so the rest of the mind affiliates to other territories comprised of value, art, and so forth.

We therefore get a split between two cultures, one scientific and one literary (or, more broadly, artistic). Literature and science are seen as operating in separate cultural realms, and interactions between them can only be of the most banal sort. Yet although they deal with separate issues, Richards also implies that they have to work in parallel. He saw advances in science dangerously outstripping those in literature and literary criticism, leaving us with an unbalanced culture where the objective, scientific knowledge that we had was not matched by a comparable system of values and emotional understanding:

As the finer parts of our emotional tradition relax in the expansion and dissolution of our communities, and as we discover how far out of our intellectual depth the flood-tide of science is carrying us . . . we shall increasingly need every strengthening discipline that can be devised. . . . The critical reading of poetry is an arduous discipline; few exercises reveal to us more clearly the limitations under which, from moment to moment, we suffer. But, equally, the immense extension of our capacities that follows a summoning of our resources is made plain.²⁴

This dual sense, of literature and science being isolated from one another, and yet part of a complementary project in which each must keep pace with developments in the other territory, has an established lineage. It goes back to the initial split which I identified with the success of Newtonian science in the seventeenth century. Since then contact between the two sides had not always been amicable. T.H. Huxley and Matthew Arnold launched sallies from opposite sides of the literature/science split in a nineteenth-century dispute about education, and the dialogue between the two territories erupted

²³Richards, *Principles* 211. Interestingly, Richards here acknowledges science’s goal of absolute knowledge which was expressed so competently by Laplace, but dismisses it as being so far off as to be of little or no concern to us.

²⁴I.A. Richards, *Practical Criticism: A Study of Literary Judgment* (1929; London: Routledge, 1964) 350-51.

into something approximating outright warfare with the famous 'two cultures' debate between F.R. Leavis and C.P. Snow in the late 1950s and early 1960s.²⁵

The fact that this divide between literature and science, which these conflicts articulate, is probably still the most popular view of the relationship between the two, indicates the amount of work that is left for literature/science criticism to do. More importantly, it also indicates the ways in which the presumptions of the first phase of the literature/science discourse still persist today.

This divide thoroughly permeates Richards' work, and indeed a lot of thinking at the time. Not only does he explicitly state that literature and science are in opposition, but other binary distinctions which he uses in his work also fall directly along a literature/science axis. Two examples will suffice to illustrate this.

He describes, for instance, two streams of experience that the reader gets from reading poetry: a minor intellectual stream (basically, the verifiable truths and certainties about what the words in a poem mean), and a more active, emotional stream from which 'all the energy of the whole agitation [in the mind] comes.'²⁶ The former is a type of scientific truth (of the sort that Descartes would appreciate) and the latter (more important aspect) is the subject of the literary criticism which Richards proposes.

A second example is provided by Richards' identification of two categories of belief in *Practical Criticism*, which are also underwritten by a literature/science dichotomy. The first, 'intellectual' belief, is required to construct a framework of consistent knowledge like that sought for by Descartes: 'The whole use of intellectual belief is to bring *all* our ideas into as perfect an ordered system as possible.'²⁷ 'Emotional' belief, on the other hand, underlies literature and the reading experience, and is about satisfying our demands as human beings: 'an emotional belief is not justified through any logical relations between its ideas and other ideas. Its only justification is its success in meeting our needs. . . .'²⁸ Richards justifies his identification of these two categories of belief by suggesting that they come from a

²⁵For the main texts in the first debate see T.H. Huxley's 1880 essay, 'Science and Culture,' *Collected Essays*, vol 3 (London: Macmillan, 1905) 134-59; and Matthew Arnold, 'Literature and Science,' *Poetry and Prose*, ed. John Bryson (London: Rupert Hart-Davis, 1954) 642-56. For the latter debate, see C.P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge UP, 1959); and F.R. Leavis and Michael Yurkin, *Two Cultures? The Significance of C.P. Snow with an Essay on Sir Charles Snow's Rede Lectures* (London: Chatto and Windus, 1962). Interestingly, T.H. Huxley's grandson, Aldous Huxley, perhaps offered the most measured contribution to this latter debate: *Literature and Science* (London: Chatto and Windus, 1963).

²⁶Richards, *Poetries* 25.

²⁷Richards, *Practical Criticism* 274.

²⁸Richards, *Practical Criticism* 277. Lyotard's distinction between scientific and narrative knowledge is similar to that here proposed by Richards. However, by showing that scientific knowledge is dependent upon narrative knowledge Lyotard collapses the distinction between the two, and thus goes significantly further than Richards. I deal with this on page sixteen.

natural division in the mind between the rational (scientific) side of our nature, and the emotional (artistic) side: 'Behind the intellectual assumption stands the desire for logical consistency and order in the receptive side of the mind. But behind the emotional assumption stands the desire or need for order of the whole outgoing emotional side of the personality, the side that is turned towards action.'²⁹ The effect of this is to make the literature/science division appear wholly natural, and therefore unquestionable. Note also that the privileging of order again appears as an important underlying cultural assumption.

Yet, paradoxically, although Richards presents the literature/science split as natural, and although science appears as a threat to the rest of the culture, there is also a desire, in his work, for literary criticism to emulate science. He draws on psychology to confer a degree of scientific authenticity to his work ('enough is known [of the mind] for an analysis of the mental events which make up the reading of a poem to be attempted. And such an analysis is a primary necessity for criticism');³⁰ and he implies that the literary critic can achieve the same objective distance from his/her object of study as the scientist.

He also wishes to establish literature, and the study of it, at the centre of the culture, a position occupied with increasing conviction by science ever since its displacement of religion during and after the Enlightenment:

The central dominant change may be described as the Neutralization of Nature, the transference from the Magical [i.e. religious] View of the world to the scientific. . . . [The Magical View] has been decaying slowly for some three hundred years, but its definite overthrow has taken place only in the last seventy. . . . [I]t is no longer the world-picture which an informed mind most easily accepts.³¹

With nature being 'neutralized,' and religion rendered impotent by scientific successes, there was a need to reinscribe value (an extremely important term for an understanding of Richards' work) into the culture.

The way to do this, for Richards, was to focus on the values which literature had to offer us. Significantly, early on in *Principles of Literary Criticism*, he claims that value is 'the clue to the whole matter [of aesthetics].'³² It can be reintroduced to the culture, Richards implies, through literature and the study of literature. This

²⁹Richards, *Practical Criticism* 274.

³⁰Richards, *Principles* 62.

³¹Richards, *Poetries* 50-51.

³²Richards, *Principles* 6.

reintroduction would see the study of literature emulating science's success by supplanting it at the centre of the culture.

To see how this would work, we must now turn to the second set of questions which I want to ask of Richards' work. I have shown how he envisions the individual mind as split between two halves: an intellectual side and an emotional side. This mirrors a 'natural' split in the culture between science and literature. The intellectual sides of our minds respond to science, gradually building up a body of verifiable knowledge, and the emotional sides of our minds (the 'systems of interests') respond to literature. The second group of questions that I now wish to ask are about the potency of literature: firstly, how does it affect the individual? and secondly, how does it affect society? By answering these questions it will be possible to see how and why Richards hoped to reposition literature at the forefront of the culture.

He presents literature as an extremely potent force, which helps or inhibits the development of the reader's mind: 'The raising of the standard of response is as immediate a problem as any, and the arts are the chief instrument by which it may be raised *or lowered*.'³³ This assertion that art can have a beneficial or a malign effect is important, because it necessitates that we distinguish between good and bad, high and low, art so as to avoid exposing ourselves to negative influences. To make this distinction we need a theory of literature and of criticism.

Importantly the emphasis in this theory is again on order. I have already shown that Richards describes human development as a process of increasing systematisation and order. Consequently, to live well requires that we order our responses to the world as far as is possible: 'the fine conduct of life springs only from fine ordering of responses far too subtle to be touched by any general ethical maxims. . . .'³⁴ Great literature is important to this process, for Richards, because it provides a means by which we can order our lives. He defines good artists and good poets as being better than the majority of us because they are 'further developments of organizations'³⁵ which our minds already have, and are therefore able to 'give order and coherence, and so freedom, to a body of experience.'³⁶ In other words they are 'better organised' individuals than the rest of us. The literature that they produce therefore disseminates their superior principles of mental organisation amongst their readers:

³³Richards, *Principles* 184.

³⁴Richards, *Principles* 47.

³⁵Richards, *Principles* 153.

³⁶Richards, *Poetries* 57. It is interesting that Richards associates order with freedom. Postmodern narratives tend to equate order with control and lack of freedom, as we shall see in chapters three and five.

We pass as a rule from a chaotic to a better organized state by ways which we know nothing about. Typically through the influence of other minds. Literature and the arts are the chief means by which these influences are diffused. It should be unnecessary to insist upon the degree to which high civilisation, in other words, free, varied and unwasteful life, depends upon them in a numerous society.³⁷

Importantly, drawing on the two cultures divide which I identified earlier, Richards implies that only art, not science, can produce this better ordering of experience:

It is never what a poem *says* which matters, but what it *is*. The poet is not writing as a scientist. He uses these words because the interests whose movement is the growth of the poem combine to bring them, just in this form, into his consciousness *as a means of ordering, controlling and consolidating* the uttered experience of which they are themselves a main part.³⁸

Conversely, bad art is configured as having a negative effect by increasing chaos. In the following example bad art is popular art, with cinema used (as Richards often uses it) as the most notorious example of the dangers posed by popular culture:

No one can intensely and wholeheartedly enjoy and enter into experiences whose fabric is as crude as that of the average super-film without a disorganization which has its effects in everyday life. The extent to which second-hand experience of a crass and inchoate type is replacing ordinary life offers a threat which has not yet been realized.³⁹

So bad art is dangerous for us, Richards suggests, because it introduces 'disorganization' and 'inchoate' experiences into our minds, while good art has the opposite effect, reducing chaos and increasing order. This leads to a rhetorically powerful case for an accepted body of 'good' literature to stand at the centre of culture: the study of literature will neutralise the dangerous chaotic experiences of poor literature, and bring us more into touch with the beneficial ordering of our minds that great literature can produce.

This war between order and disorder, which Richards hurls himself into, taps directly into two important nineteenth-century debates within the sciences about order and disorder. The second law of thermodynamics, first formulated in the mid-nineteenth century, portrays chaos as a threat to the order of the universe. It suggests that entropy, a word coined by Rudolf Clausius in 1850, always increases, and it

³⁷Richards, *Principles* 43.

³⁸Richards, *Poetries* 33.

³⁹Richards, *Principles* 182.

postulates a time in the future when matter and energy will be distributed throughout the cosmos in a universally random state. This 'heat death' is given powerful expression by Norbert Wiener, writing some time after Richards: 'it is highly probable that the whole universe around us will die the heat death, in which the world shall be reduced to one vast temperature equilibrium in which nothing really new ever happens. There will be nothing left but a drab uniformity out of which we can expect only minor and insignificant local fluctuations.'⁴⁰ This sense of an impending future chaos feeds late-Victorian, and early twentieth-century, fears of disorder.

Conversely, Charles Darwin's theory of evolution (which was widely known after the publication of *Origin of Species* in 1859) configured natural history as a process of increasing systematisation and order for many Victorians.⁴¹ While thermodynamics configures change over time as a process of increasing entropy towards universal disorder and 'heat-death,' evolution and natural selection (in their early twentieth-century forms) configure it as progress towards better and better life forms.⁴² So scientific ideas fed a culture which favoured order (better, more organised life-forms) and found disorder (heat death) threatening. This is not only of incidental interest to our consideration of Richards' work, because he explicitly draws on the theory of evolution in order to shore up his arguments, and possibly refers indirectly to the second law of thermodynamics.

For instance, at the beginning of *Principles of Literary Criticism* he claims that the two pillars upon which a theory of criticism must be based are 'an account of value and an account of communication.'⁴³ Partial justification for suggesting that an account of communication is important as one of these pillars is then provided by the claim that communication was important in human evolution:

A large part of the distinctive features of the mind are due to its being an instrument for communication. An experience has to be formed, no doubt, before it is communicated, but it takes the form it does largely

⁴⁰Norbert Wiener, *The Human Use of Human Beings*, 2nd ed. (1950; London: Eyre and Spottiswoode, 1954) 31.

⁴¹In *Wonderful Life*, referenced above, Gould makes the point that evolution does not necessarily entail a process of increasing complexity of the sort imagined here - Richards is not, therefore, drawing on a version of evolution which is established 'fact,' so much as a particular reading of the theory. It should be noted that in talking about Darwin here, I am not commenting so much on *Origin of Species* (which can be read as denying that there is any progress in a real sense), but am more concerned with how his ideas of evolution permeated Victorian culture. See chapter seven for a longer discussion of both *Wonderful Life* and notions of progress in relation to evolution.

⁴²These two 'arrows of time' are compared by Ilya Prigogine and Isabelle Stengers in *Order Out of Chaos: Man's New Dialogue with Nature* (1984; London: Flamingo, 1985) which I discuss in chapter five. It ought to be noted that the theories are not in direct contradiction - evolution involves locally confined increases in order against a background of increasing chaos.

⁴³Richards, *Principles* 17.

because it may have to be communicated. The emphasis which natural selection has put upon communicative ability is overwhelming.⁴⁴

Although value, the other pillar, is not given a similar scientific justification in *Principles*, it is indirectly referenced five years later in *Practical Criticism*, when it is discussed in terms which again recall the theory of evolution. In this example he is talking about the human mind, suggesting that the ideal mind, the one of most value, is one where order has completely overcome chaos: the completed mind 'would be that perfect mind . . . in which no disorder, no mutual frustration of impulses remained.'⁴⁵ This idea is then supported by the suggestion that development, in humans and animals, is naturally towards this completed, ordered, and complex mind. Unlike in the last example, evolution is not explicitly cited here, because development, in this case, is individual development over the course of a life, rather than the evolution of a species. However, the terms in which Richards presents this argument inevitably recall a notion of Darwinian evolution as natural development towards a state of greater complexity and order:

[The] development with man (and his animal neighbours) seems to be predominantly in the direction of greater complexity and finer differentiation of responses. . . . [We can conceive of the organism as] tending to relieve internal strains due to these developments imposed from without. And a reordering of its impulses so as to reduce their interferences with one another to a minimum would be the most successful - and the most 'natural' - direction which this tendency would take.⁴⁶

The reference to nature is used to make his view of human development the 'natural' one. His assumption of a teleology - of progress towards a goal - is also characteristic of the first phase of the literature/science discourse, and mirrors Descartes' and Laplace's assumption that we can accumulate information towards a future condition of ultimate understanding. I will show in chapter seven how this sort of teleology is under threat in postmodern discourses.

The second law of thermodynamics does not receive the explicit reference that the theory of evolution does in Richards' work. Nevertheless, his fear of chaos is presented in a way which carries heavy resonances of scientific notions of entropy. For example, commenting on a perceived decline in the quality of literature, he says:

⁴⁴Richards, *Principles* 17.

⁴⁵Richards, *Practical Criticism* 285.

⁴⁶Richards, *Practical Criticism* 286-87.

The most probable reasons for this are the increased size of our 'communities' (if they can be so called, when there remains so little in common), and the mixtures of culture that the printed word has caused. Our everyday reading and speech now handles scraps from a score of different cultures. . . . [I am referring] to the fashion in which we are forced to pass from ideas and feelings that took their form in Shakespeare's time or Dr Johnson's time to ideas and feelings of Edison's time or Freud's time and back again.⁴⁷

To preserve culture against entropy it must be closed off, sealed against the influence of other cultures, much as literary territory must be protected against the encroachment of science.⁴⁸ The 'order' of culture is threatened by dilution and disorder if it is not rigidly protected against outside influences (although Richards suggests that we should erect temporal boundaries between our culture and others in history, it is similar in kind to the desire to erect geographical boundaries between 'English' and other literatures). This is in stark contrast to notions of order and disorder which we will find in the third phase of the discourse, where chaos is interpreted as a fecund site for new meanings, in chaos theory, and where postmodernist literature mixes discourses from different cultures (particularly from high and low cultures) quite explicitly.

For Richards, however, the artist is a champion of order over disorder:

The artist is concerned with the record and perpetuation of the experiences which seem to him most worth having. . . . His work is the ordering of what in most minds is disordered. . . . [W]hen he succeeds, the value of what he has accomplished is found always in a more perfect organization which makes more of the possibilities of response and activity available.⁴⁹

This answers the second set of questions which I posed of Richards' work: 'good' art has the effect of increasing order in the individual and in society. We can now move on to the final set of questions that I wish to ask of Richards' work, about what all this means for our reading practices: how should we read literature? and, what is the role of the literary critic?

A good reader, for Richards, is one who lays him or herself open to the positive, ordering effects upon the mind of high quality literature. Reading well is

⁴⁷Richards, *Practical Criticism* 339.

⁴⁸This is not identical to the scientific notion of entropy because the second law of thermodynamics indicates that closed systems increase in entropy. However, Richards' desire to protect culture in an autonomous space (preserving order by keeping the disorder of other cultures away) does resonate with a fear of entropic decline.

⁴⁹Richards, *Principles* 46.

about recreating the writer's experience in the mind, because this allows access to the writer's superior ordering of experience: 'the reader who approaches it [poetry] in the proper manner [will get] a response which is as passionate, noble and serene as the experience of the poet, the master of speech, because in the creative moment he is the master of experience itself.'⁵⁰

However, this does not mean that we should focus directly on the writer's mind, which is 'far too happy a hunting-ground for uncontrollable conjecture.'⁵¹ Instead, we must focus instead on the text itself, where the writer's ordering of experience is manifested. This explains the nature of the project in *Practical Criticism* where Richards outlines an experiment he carried out with his students at Cambridge. The introduction tells us that he was in the habit of distributing sheets of unannotated poems to his students, asking them to comment freely in writing about them. After collecting these comments, he would lecture on them the following week.

Over a third of *Practical Criticism* is comprised of these responses from students to unidentified poems. The point of reproducing these comments is to show us how, even amongst students being educated at Cambridge, there was a general inability to distinguish good literature from bad, many of the comments failing to identify the work of the great poets, and much of it misusing the available armoury of critical terminology.

The assumption upon which this test was based reveals an important point about the methodology of Richards, and indeed of New Criticism as a whole: the words on the page are all that is important. The conclusion that Richards drew from his experiment was that because his students were unable to distinguish great literature from poor, they were reading incorrectly. Later literary criticism might have drawn a different conclusion from the same results: there is nothing inherently great about 'great' literature, and our ideas about what constitutes high and low art are based on ephemeral cultural assumptions.

How, though, could Richards' students become good readers of literature? - by concentrating on the text, identifying which features of a work of art (of the words on the page) produced which effects in the mind: 'often the critic . . . affirms that the effect in his mind is due to special particular features of the object. In this case he is pointing out something about the object in addition to its effect upon him, and this fuller kind of criticism is what we desire.'⁵² To become this better sort of reader we need to be

⁵⁰Richards, *Poetries* 45.

⁵¹Richards, *Principles* 20.

⁵²Richards, *Principles* 15.

'sensitive,'⁵³ and the habit of good reading is a question of developing this sensitivity. This allows one to distinguish good from bad literature in an objective sense, overriding one's personal feelings as one comes to a detached judgement about the literary work in question.

Therefore, by implication, the role of the literary critic is two-fold: to act as a guide for those unable to judge which literature is and is not of value; and to impart the secrets of making such judgements. This is certainly the role of the implied author in *Practical Criticism*, where Richards sets himself up as someone who knows the difference between good and bad literature, and who can guide the rest of us as we try to reach a similar status as adept readers. Indeed, there is something mystical about Richards' presentation of the skill of the literary critic. While the literary strand in this phase of the literature/science discourse emphasises realism, and the author as omnipotent god, the literary-critical strand emphasises practical criticism, and the literary critic as priest/vicar to the god's word.

These emphases upon the text, and upon the beneficial effects of reading good literature, were highly influential. After all, Richards and his generation were largely responsible for the establishment of English as an important subject in the Higher Education system, and the influence of such notions as 'practical criticism' can be seen in present-day school curricula.

Yet, as I have shown, the emphases which Richards places upon these things are not necessarily expressions of the natural or right ways to read literature. They are partially determined by the social and historical context in which they arose, drawing from notions of human reason and of knowledge which are firmly rooted in the Enlightenment, and which can be found as far back as Descartes' *Discourse on Method*. Simultaneously, they also react against some of the outgrowths of the Enlightenment - against the rise and success of the new disciplines of the sciences, which seemed to be overturning so many of the certainties upon which Western civilisation had been based, and against a perceived moral void at the heart of society. The study of literature would help to preserve some sense of stability by putting us in touch with the minds of exceptional individuals who had aspired to, and reached, a greater inner order than we could hope to attain.

It is no coincidence that at the same time as Richards is writing, T.S. Eliot produces his influential essay, 'Tradition and the Individual Talent' (1919),⁵⁴ which postulates a vision of an evolving (but essentially stable) literary tradition. Eliot's and Richards' formulations of a fairly stable canon, or tradition, of English literature (an

⁵³Richards, *Principles* 76, 119. Richards, *Practical Criticism* 224.

⁵⁴T.S. Eliot, 'Tradition and the Individual Talent,' *Selected Prose of T.S. Eliot*, ed. Frank Kermode (London: Faber, 1975) 37-44.

idea that was given more definite form by F.R. Leavis's *The Great Tradition*), combined with the contention that value is 'the clue to the whole matter' of literature, express a yearning for a more certain world, and the hope that high art can provide some moral certainty in a chaotic contemporary world.

Three binary oppositions underwrite Richards' work, and that of others in literary academia who hold with his principles. The first two, loudly voiced and closely associated, are those between good and bad literature, and order and chaos. The third, more muted because it seems so natural, is that between literature and science. These binary oppositions are used to define and establish what the New Critics mean by literature, and what they think the study of it should achieve.

To end this chapter, it will be useful if I briefly consider a possible complication to my suggestion that New Criticism naturally associates with realist literature, and then also show how it is not completely different from later literary theory. The first of these tasks arises because, simultaneous with the establishment of English as an important academic subject, by critics like Richards, is the growth of modernist literature.

This new literature forms the second phase in the literary strand of the literature/science discourse, because it calls into question the assumptions of much realist literature. As a result we might expect critics like Richards, whose criticism is entrenched in the first phase, to find it repulsive, but of course this is not the case. Richards' work, and that of others like him, is a response to an uncertain contemporary world. A perceived moral stability, and the apparent certainty of progress, had been shattered by cataclysmic contemporary events like the First World War. Modernist literature seemed to give expression to this sense of crisis, with literature like Eliot's 'The Waste Land' (1922) offering a vision of a bleak contemporary world which accorded with Richards' fears for society, and which tried to find literary forms adequate to this new world. This shows how the divisions between different phases of the literature/science discourse are not clear cut. One phase does not preclude all the others. Rather, as I have already indicated, I am trying to pin down the emphases which are apparent within the discourse at different stages of its development.

Tied in with this, is the observation that the criticism of Richards and his contemporaries has certainly not disappeared, despite the rise of structuralism, and later, poststructuralism. Indeed, some of Richards' assumptions are still very much a part of the criticism which we practice today - we might not, for example, openly subscribe to the notion that there is such a thing as universally great literature, but the books which we choose to teach tend to be the ones which we personally, and amongst our peers in higher education, find to be of 'better' quality than others.

More specifically, we can find the seeds for the later development of literary theory in Richards' work. I will now look briefly at these in order to demonstrate how later developments in the literature/science discourse are not complete breaks from the

first phase. They are, rather, the placing of emphases on points which had before been muted. One important instance of this comes from Richards' assumption that a natural order underlies our experience of art - later instances of literary criticism make similar points to Richards, but replace this natural order with a social order.

For instance, some of his comments about psychology and the human mind, if developed in a slightly different way, lead to some of the conclusions that structuralist criticism makes. He admits that because minds are essentially self-enclosed we never get direct access to another's thoughts, and that as a result communication is problematic: 'communication defined as strict transference of or participation in identical experiences does not occur.'⁵⁵ Furthermore, any observations that we make about an art object do not reveal qualities that are inherent in that object, but only exist in our perception of it: 'Whether we are discussing music, poetry, painting, sculpture or architecture, we are forced to speak as though certain physical objects . . . are what we are talking about. And yet the remarks we make as critics do not apply to such objects but to states of mind, to experiences.'⁵⁶ Hence, we often reify art objects, ignoring the fact that their value lies in our perception of them, not in them themselves: 'We are accustomed to say that a picture is beautiful, instead of saying that it causes an experience in us which is valuable in certain ways.'⁵⁷

For the structuralists too, meaning does not reside in the individual piece of art or literature. However, although Richards does not find meaning in the art object itself, he implies that there is a universal structure to the human mind that leads us all to experience meaning (or beauty, or whatever) in the same way - this explains why it does not matter too much, for the purposes of New Criticism, if we do reify a picture by saying that 'it' is beautiful. The structuralists make a slightly different point: the individual unit of literature is an instance of *parole*, an expression on the surface of a deep-lying *langue*, a structure which generates meaning. This structure is social or cultural.

For Richards, because the same things cause different minds to react in similar ways, we can talk about things as though they have universal qualities - this suggests that there is something natural about our responses to literature. For the structuralists however, meaning is generated not by the natural order of the mind, but by social structures - language, or genre perhaps. So the move towards structuralism might be configured as a move from a belief in natural structures, as the repository of all meaning, to a belief that meaning is generated by social structures. Perhaps the

⁵⁵Richards, *Principles* 135.

⁵⁶Richards, *Principles* 14.

⁵⁷Richards, *Principles* 13.

emphasis on social structures is a response to a dawning legitimization crisis, a lack of confidence that nature will yield up meaning. Despite these differences, the general thrust of New Criticism and structuralism is the same: concentrate on the text alone; only trust the words on the page.

A similar point can be made by another example taken from Richards' work, in which he talks about language and psychology. Like the structuralists, he admits that words do not give us direct access to experience, and can only stand in for it:

most thoughts are 'of' things which are not present and not producing direct effects in the mind. This is so when we read. What is directly affecting the mind is words on paper, but the thoughts aroused are not thoughts 'of' the words, but of other things which the words *stand for*. How, then, can a causal theory of thinking explain the relation between these remote things and the thoughts which are 'of' them?⁵⁸

The structuralists would make a similar point, but would elaborate it by introducing the language of semiology - rather than merely pointing out that words '*stand for*' things (it is interesting that Richards thinks this observation important enough to italicise it), they would talk of words as *signifiers* of actual things (*signifieds*), and that when put together the two form *signs*. They would answer the question that Richards poses at the end of the quotation by elaborating a semiological system. Richards, on the other hand, supposes that the answer lies in psychology, and he uses this to endorse his view of the mind, language, and literature: minds experience similar things in similar situations, so we can talk about shared values and truths.

We can even push these parallels between Richards' criticism and structuralism further. In talking about language in *Science and Poetry*, he comments that words do not mean in themselves, but only by virtue of their relationship to other words - he says, for example, that 'father' has meaning only in relation to 'mother' and 'child.'⁵⁹ Put this observation next to the previous one that words are divorced from the things they stand for, and you come very close to the structuralist conception of language: language is an arbitrary system of signs with meaning being generated by the relationships between these signs.

That Richards does not make this connection, and that he hangs on to stable and ordered notions of meaning, indicates the place of his work, and that of his contemporaries, in the first phase of the literature/science discourse. Stable and ordered notions of meaning are what underwrite Descartes' *Discourse on Method*, classical science and realist literature.

⁵⁸Richards, *Principles* 97.

⁵⁹Richards, *Poetries* 109.

When chaos comes to be valued over order, and is actually redefined, as I shall show to be the case with the advent of the final, postmodernist phase of the discourse, then notions of knowledge and of legitimation must change. If we read *Principles of Literary Criticism*, *Science and Poetry*, and *Practical Criticism* with this revaluation of order and chaos in our minds, then Richards' work seems to make less sense. The strong order/disorder divide, with a heavy emphasis placed upon order as positive and disorder as negative, is the cultural assumption which underwrites New Criticism. It also underwrites the belief in an ordered culture, split down the middle between the arts and the sciences. To see how these beliefs were thrown into crisis in science, literature, and literary theory, we need to move on to the second phase of the core literature/science discourse.

Chapter Two

The Second Phase of the Core Literature/Science Discourse: Modernism / Post-Newtonianism / Formalism and Structuralism

The views of knowledge and legitimation which I analysed in chapter one, and which I showed to be equivalent to those proposed by early-Enlightenment thinkers like Descartes, enter a second phase of their development at around the beginning of the twentieth century. This second phase can be thought of most profitably as a period of crisis in which traditional views of reality are called into question. As with the first phase of the discourse, this second phase is not wholly unified, there is no single moment when all three strands of the discourse come into crisis, and the significance of this phase of the discourse is different for each strand.

However, what does provide a crucial link between the science, the literature and the literary theory, justifying my consideration of them as different strands of the same discourse, is that the crisis each encounters in this second phase is equivalent in one crucial respect: all three suggest, to a greater or lesser degree, that reality resides not in an objective world, exterior to the observer, but in the observer's perception of that world. In other words they complicate the simplistic separation between mind and world upon which Descartes' philosophy rests. In order to demonstrate this I will make some direct comparisons between the different strands of the discourse, before going on to consider them individually.

Remarkably there is substantial evidence that the supposedly disparate worlds of literature and science shared the new outlook on reality. The American modernist poet, Wallace Stevens, wrote of it in these terms in 'A Collect of Philosophy' in 1959:

The material world, for all the assurances of the eye, has become immaterial. It has become an image in the mind. The solid earth disappears and the whole atmosphere is subtilized not by the arrival of some venerable beam of light from an almost hypothetical star but by a breach of reality. What we see is not an external world but an image of it and hence an internal world.¹

In this formulation, reality no longer resides in an external world to which our minds can gain objective access; rather, they create what we call reality by a mental process of interpretation. Reality, for Stevens, is therefore an internal image of an external world, not the external world itself. We can see how this insight informed his poetry long before 1959 if we look briefly at the first stanza of 'Anecdote of the Jar,' published in 1923:

¹Wallace Stevens, 'A Collect of Philosophy,' *Opus Posthumous*, ed. Samuel French Morse (London: Faber, 1957) 191.

I placed a jar in Tennessee,
 And round it was, upon a hill.
 It made the slovenly wilderness
 Surround that hill.²

The key to these deceptively simple four lines is the relationship between the jar and the wilderness - how can a jar 'make' wilderness surround the hill? The answer is, of course, that it cannot in any straightforward material sense, but what it does do is alter the observer's perception of the wilderness. Suddenly it has a centre-point, and even though the wilderness has not itself changed, it now surrounds 'that' hill in particular, simply because the onlooker observes it to do so. The poem concentrates, therefore, on reality as it is experienced, rather than as it exists, independent of anyone's apprehension of it.

The physicist Werner Heisenberg's description of scientific research displays a remarkably similar attitude towards reality to that proposed by Stevens in 'A Collect of Philosophy':

the aim of research is no longer an understanding of atoms and their movements 'in themselves', i.e., independently of the formulation of experimental problems. . . . [T]he common division of the world into subject and object, inner world and outer world, body and soul, is no longer adequate and leads us into difficulties. Thus even in science *the object of research is no longer nature itself, but man's investigation of nature*. Here, again, man confronts only himself.³

Just as Stevens suggested that we can only deal with an 'internal world,' not an external one, so Heisenberg claims that scientific research can only take as its subject 'man's investigation of nature,' not nature itself. Heisenberg is a key scientist in this phase of the literature/science discourse, particularly because of the popularisation of his uncertainty principle (1927), and so his emphasis upon reality as it is perceived, rather than reality itself, is important.

It is also significant that he ties this insight to the demise of a viewpoint which I have already identified as key for an understanding of the Enlightenment: the sharp distinction between observer and observed. By suggesting that traditional distinctions

²Wallace Stevens, 'Anecdote of the Jar,' *Harmonium*, Poetry Reprint Ser. (1923; London: St. James Press, 1975) 112.

³Werner Heisenberg, *The Physicist's Conception of Nature*, trans. Arnold J. Pomerans (1958; Westport: Greenwood, 1970) 24. Aldous Huxley also uses this quotation from Heisenberg in *Literature and Science* (referenced above, 65), demonstrating his willingness, as Stephen Weininger argues, to go beyond the bounds of the 'two cultures' debate (which was then raging between Leavis and Snow). Stephen Weininger, 'Introduction: The Evolution of Literature and Science as a Discipline,' *Literature and Science as Modes of Expression*, ed. Frederick Amrine, Boston Studies in the Philosophy of Science 115 (Netherlands: Kluwer Academic Publishers, 1989) xiii-xxv.

between subject and object, inner and outer worlds, and body and soul have been rendered irrelevant, he problematises the first principle of the Cartesian method, the unquestioned split between the rational mind and that which it observes. This suggests that the major foundations of the Enlightenment world-view are in crisis in this phase of the literature/science discourse.

A similar attack upon an Enlightenment view of reality is also to be found in the literary theory, formalism and structuralism, which I identify with this phase of the discourse. Terence Hawkes, looking back in 1977 on the rise of this literary theory, and writing in terms that again display an astonishing similarity to those in which Stevens and Heisenberg wrote, claims that:

[Structuralism] is the result of a momentous historic shift in the nature of perception which finally crystallized in the early twentieth century, particularly in the field of the physical sciences, but with a momentum that has carried through to most other fields. The 'new' perception involved the realization that despite appearances to the contrary the world does not consist of independently existing objects. . . . In fact, every perceiver's *method* of perceiving can be shown to contain an inherent bias which affects what is perceived to a significant degree. . . . Accordingly, the *relationship* between observer and observed achieves a kind of primacy. It becomes the only thing that *can* be observed. It becomes the stuff of reality itself. Moreover the principle involved must invest the whole of reality.⁴

Like Heisenberg, Hawkes associates the new approach to reality with the demise of an older view ('despite appearances to the contrary the world does not consist of independently existing objects'). Furthermore, he acknowledges that this view is not limited to literary theory but is part of a 'momentous historic shift' that extends beyond the bounds of his subject, particularly into the realm of the physical sciences.

By arguing for the existence of a three-phase literature/science discourse, I also, like Hawkes, am inevitably suggesting that there are periods when 'momentous historic' shifts occur, marking transitions between each phase of the discourse. In this respect I am drawing upon the notion which is currently popular in literary criticism that 'paradigm shifts' occur when significant changes in world-view take place. This is also a view which has found some favour in the sciences, particularly from the philosopher of science Thomas Kuhn, as a means to describe the change in outlook needed to make significant scientific advances.⁵ However, in considering a discourse

⁴Terence Hawkes, *Structuralism and Semiotics*, New Accents (1977; London: Methuen, 1983) 17.

⁵See *The Structure of Scientific Revolutions*, referenced above.

as broad as the literature/science one I have postulated, there are some complicating factors in this notion that historical watersheds mark significant changes of direction.

The notion that these changes in direction are brought about by a shifting historical climate must take into account the fact that literature and science are not only products of the historical moment, but also determine its character. This rather complex relationship means that when changes do come, they do not occur equally in all places and at the same time.

Furthermore, we cannot ignore the influence of individual disciplinary traditions in shaping the course of literature, science, and literary theory. An appropriate metaphor with which to understand these complex changes is that of a river delta. It is useful to think of the literature/science discourse, not just as a river which changes its direction uniformly at certain historical moments, but rather as a river which is entering its delta, shifting direction certainly, but also splitting and branching out into various sub-streams which diverge and run into each other. With this thesis I am tracing the route from the Enlightenment to the postmodern, following only one important selection of channels and leaving others (for instance, those which follow the continued development of the realist tradition, and of classical physics, into the present) unmapped.

This chapter explores the nature of one of these important shifts of direction, in which the three channels of literature, science and literary theory turn sharply, and in rough concordance, from the Enlightenment towards a period of crisis. I have already demonstrated how all three share similar concerns at this point in their development, so I shall now go on to analyse them in greater detail on an individual basis. This turn away from the Enlightenment is perhaps most obvious in literature's turn from realism to modernism, and so it is to this that I will first turn my attention.

Modernism

As indicated by the quotation from Wallace Stevens at the beginning of this chapter, I will suggest that, at its most fundamental level, modernist literature involves a questioning of the realist faith in a shared external reality. We can find support for this view from Brian McHale, who argues that modernist literature is concerned with raising issues that are predominantly epistemological, foregrounding questions about how to present reality.⁶

These questions arise from a dissatisfaction with the ability of the old narrative forms (broadly speaking, those employing realist conventions) to adequately represent the world - or, at least, to adequately represent the new technological and

⁶Brian McHale, *Postmodernist Fiction* (New York: Methuen, 1987) 9.

industrial world of the twentieth century. The cut-off point between realism and modernism is impossible to determine, although there are a number of suggestions. Virginia Woolf is famously specific ('in or about December, 1910, human character changed'),⁷ but perhaps a more tempting watershed is that of the First World War, providing, as it does, a cataclysmic event, a sharp, sustained rebuff to the myths of progress associated with nineteenth-century society.

However, it would be wrong to search too eagerly for exact dates in our attempts to draw divisions between literary periods. Indeed, it is possible to find transitional features in literature published long before the First World War, and indeed before Woolf's 1910 cut-off point. Henry James's *The Turn of the Screw* belongs in this transitional category, and focusing on it gives us a way of seeing just how notions of reality began to change in the late nineteenth century towards an outlook which is identifiable as modernist. The novel also makes an interesting comparison to *Frankenstein*, which I used to illustrate realist conventions in chapter one, because it shares a number of structural similarities with it. The subtle differences between these two novels provide some telling insights into the shift from realism to modernism.

As with *Frankenstein*, there are a number of different narrative levels down which we descend as we read the novel. Indeed, the structural similarity between the two books is quite pronounced: in each we begin with the author of the work (Shelley/James); move on to a narrator who is employed to convey the story to the outside world (Walton/the first, unnamed narrator in *The Turn of the Screw*); then drop another level to a second narrator (Frankenstein/Douglas); and finally move down to the last narrative level (the creature/the governess). Earlier, I suggested that this nesting of narratives, as it appears in *Frankenstein*, operates as a guarantee of truth, a reassurance for the reader that it is all right to maintain suspension of disbelief in the face of this extraordinary tale. The effect of a similar technique is diametrically opposite in *The Turn of the Screw*, serving to disturb our notion of a stable reality. This is achieved by subtle distortions of the technique that works as such a reassurance in Shelley's novel.

Most crucially, although the number of narrative levels is the same in both books, in *The Turn of the Screw* the symmetry is disrupted. We move down through the narratives of the unnamed narrator and Douglas, to that of the governess (rather more quickly than we do in *Frankenstein*), but we do not rise back up through the levels at the end of the novel as we might expect. On reading the novel the introductory chapter seems as though it will be part of a classic framing device, and

⁷Virginia Woolf, 'Mr. Bennett and Mrs. Brown,' *Collected Essays*, vol. 1 (1923; London: Hogarth Press, 1966) 320.

we expect to return to the cosy imagery of the hearth, around which the ghost stories are being told, at the end of the book. However, the second half of the frame is missing, and the novel ends with the sudden horror of Miles's death to subvert our expectations and assert itself as the fundamental level of reality. This disruption of our realist assumptions is supplemented by the well-documented debate as to whether the ghosts are real or the product of the governess's imagination, initiated by Edmund Wilson's Freudian reading of the novel in 1934.⁸ These combine to produce an early example of the more thorough-going interrogation of literary form produced by the modernist movement.

A brief focus on a key modernist technique, stream of consciousness, will allow us to see how this questioning of reality, and its epistemological consequences, developed during the early years of the twentieth century when modernist literature was in the ascendancy. It is reasonable to suggest that the technique evolves in response to the need to articulate the new view of reality, outlined at the beginning of this chapter.

The difference between a stream-of-consciousness narrative, and that of either an omniscient narrator, or a reliable first-person narrator, is dramatic. This is because an external, shared reality is always slightly further removed from us with a stream of consciousness. We do not get direct access to the fictional world that the characters inhabit, but only to their perceptions of that world.

This can be illustrated by reference to an episode in Virginia Woolf's *Mrs Dalloway* (although this novel can be said to be more of an interior monologue than a stream of consciousness, the effect is the same). Early on in the book a car passes through the streets of London. Rather than an objective description of the car and its inhabitants, we are instead presented with a plethora of individual, subjective reactions to the car and speculations as to whom it contains.⁹ In other words the reality (albeit fictional) is not presented to us directly, but is distanced from us, focused only through the subjective and partial perceptions of those who see it. We never find out whom it contains because, as in the rest of the novel, we are largely isolated within the minds of the characters who populate Woolf's depiction of London in 1922.

There therefore develops a significantly different pact, between author and reader, from the one which is associated with realist fiction's bridging of the gulf between the two. Instead of an assumption that writer and reader share a view of reality, which can be taken as a given, the author emphasises that it only exists in the

⁸Edmund Wilson, 'The Ambiguity of Henry James,' *A Casebook on The Turn of the Screw*, ed. Gerald Willen (New York: Crowell, 1959) 115-53.

⁹Virginia Woolf, *Mrs Dalloway* (1925; London: Grafton, 1976) 14-20.

form of our individual interpretations of it. This takes us back to the observation made by Wallace Stevens that we only ever see an 'internal' world.

Significantly, this does not involve renouncing the concept of reality altogether. Instead, it focuses on the mediation of reality by the mind, dragging us away from the objective, physical to the subjective, mental world. *Mrs Dalloway* makes this explicit thematically as well as formally.

It is a novel comprised of circles and centres, from the 'leaden circles [that] dissolved in the air' when Big Ben chimes,¹⁰ to London as the centre of the Empire, and Westminster (where most of the action is located) as the political centre of the city and the country. If reality does exist, if it is possible to find an answer that enables one to speak authoritatively and objectively about Britain in the 1920s, then here, surely, is where one will find such an answer. Yet Woolf emphasises the elusive nature of such a reality, how the centre of the circle is always just out of reach.

Richard Dalloway, an M.P., is as unable to solve the social problems facing British society as everyone else, as incapable of penetrating to an answer as those whom he pities. In a passing thought about prostitution, he begins to register a critique of the social system, but soon trails away into a fudging generalisation, unable even to conceive that he might have the power to do something positive: 'and prostitutes, good Lord, the fault wasn't in them, nor in young men either, but in our detestable social system and so forth. . . .'¹¹ Even the prime minister, whose attendance at Clarissa's party is so eagerly anticipated, turns out to be a rather disappointing figure when he arrives, as if even this man who stands at the centre of British political life, is not quite sure what is going on: 'He looked so ordinary. You might have stood him behind a counter and bought biscuits - poor chap, all rigged up in gold lace.'¹²

More importantly, the failure of Clarissa's personal quest for significance, of which she becomes aware on hearing of Septimus's death, is presented as a failure to penetrate to the centre: 'Death was an attempt to communicate, people feeling the impossibility of reaching the centre which, mystically, evaded them; closeness drew apart; rapture faded; one was alone.'¹³

Yet, although reality has lost its tangibility in modernist literature, it is still assumed to be there. Clarissa still searches for the centre, even though she may not

¹⁰Woolf, *Mrs Dalloway* 6.

¹¹Woolf, *Mrs Dalloway* 103.

¹²Woolf, *Mrs Dalloway* 152.

¹³Woolf, *Mrs Dalloway* 163.

reach it. Indeed, this search leads to a form of transcendence, a form of reality, when she empathises with Septimus in a way which is almost mystical, after hearing about his death. At this point she does achieve some degree of contact with him, does touch a centre, even if it is only to realise more profoundly how out of reach reality and significance usually are.

More importantly, reality remains a tangible concept in the pact between reader and writer. The style of the novel is alien (at least, it is alien to the reader of realist fiction - perhaps, for its alienating effect, even presupposes a reader of realist fiction), but there is access to a form of reality. We might not be in the centre, placed straight into a 'real' world by the writer, but we are given direct access to reality as it is perceived by the characters. The following, well-known passage from 'Modern Fiction,' illustrates this project of modernist literature perfectly:

[I]f a writer were a free man and not a slave . . . there would be no plot, no comedy, no tragedy, no love interest or catastrophe in the accepted style, and perhaps not a single button sewn on as the bond street tailors would have it. Life is not a series of gig-lamps symmetrically arranged; life is a luminous halo, a semi-transparent envelope surrounding us from the beginning of consciousness to the end.¹⁴

The modernists do not, therefore, quibble about the existence of reality, but about the way in which it should be presented. Ironically, Woolf's plea for a new, modernist style is here predicated on the fact that it would be more realistic than realism (in reality 'life is a luminous halo,' and we must seek to present it in this way). The status of reality has changed in early twentieth-century minds, but modernist techniques are founded on the belief that a new way of telling will connect us directly to it.

Modernist narratives and techniques are therefore legitimated by the access they are perceived to give to a more direct expression of lived experience. By focusing on the particular, on the individual perception, they are able to bring us into contact with what it is like to perceive and to be. To return to the metaphor of the game which I used to illustrate the relationship between author and reader, in relation to realist fiction, in chapter one, if realist fiction involves a game which is never begun, modernist fiction is a game of follow-my-leader. There is no confrontation between opponents and no real end goal, just the perpetual need to keep following the author as he or she leads us into new territory, and develops new techniques for rendering lived experience more accurately. So, although modernist fiction does indeed pose epistemological questions, as McHale has argued, the questions that it

¹⁴Virginia Woolf, 'Modern Fiction,' *Collected Essays*, vol. 2 (1925; London: Hogarth Press, 1966) 106.

poses do not go beyond this and remain on the level of questions about how to present reality.

As an aside, it is interesting to note that modernist literature only poses these sorts of questions if a reader comes to it with realist expectations. There is nothing intrinsic to modernist literature which interrogates how we perceive reality. Quite often, the techniques of modernist fiction are presented to us as givens - they exist, without further authorial comment, in the text. These only occasion surprise in us if we are not expecting them (if we expect the novel to be realist). To draw upon Russian Formalist terminology, they can only seek to disturb us by assuming that we are not expecting them, because it is only then that they can 'defamiliarise' us.¹⁵ Therefore there is a sense in which the disturbing effect of modernist fiction actually requires that realism remain the dominant aesthetic, as though modernist fiction always codes itself into a position at the margins of culture.

However, although modernist literature can only disturb us, and force us to ask epistemological questions, if we expect a realist novel, its focus on reality as perceived, not given, is intrinsic to it. This shift from the universal to the local is also apparent within the scientific strand in this phase of the discourse, although it is much less pronounced, or at least much less sustained, than in the literary strand. It is to this that I now turn my attention.

Challenges to Classical Science

The second phase of the scientific narrative involves a challenge to the Newtonian view of the universe, much as modernism involved a challenge to, and a reaction against, realism in the literary strand. However, it is a phase which is not so crucial to the scientific narrative strand - or, at least, it is one which is less sustained. It involves a crisis, a sense in which the Newtonian paradigm is called into question, but this crisis results in a fairly rapid movement to another vision of reality (the 'postmodernist' one which will be described in chapter three).

There are two factors which make this phase of the scientific strand of the discourse much more insubstantial than either the literary or the literary theory strands. Firstly, different histories of science suggest different times when Newtonian science went into crisis. Secondly, scientific ideas which are sometimes seen to be moments of crisis (in my terms, second-phase discourses), are presented in other histories as either first-phase discourses (equivalent to Newtonian science), or third-

¹⁵For a key essay on defamiliarisation see Victor Shklovsky, 'Art as Technique,' *Russian Formalist Criticism: Four Essays*, trans. Lee T. Lemon and Marion J. Reis, Regents Critics Ser. (Lincoln: Bison-U of Nebraska P, 1965) 3-24.

phase discourses (completely renouncing Newtonianism, rather than just constituting a crisis in it). I will begin with the disputed timing of the crisis in the Newtonian scientific world-view.

One possibility is that it occurred in the nineteenth century, with the formulation of the second law of thermodynamics. This is the view put forward by Ilya Prigogine and Isabelle Stengers in *Order Out of Chaos*, which I will discuss in chapter five. They argue that it introduces the idea of irreversibility into science for the first time (and leads ultimately to their version of chaos theory, which I associate with the third phase of the discourse). In the Newtonian paradigm, time was, in theory, reversible because actions could be turned into re-actions by reversing the terms of the equation and tracing the evolution of the system back through time. There was, therefore, no intrinsic 'arrow of time,' no reason to believe that time 'should' run in any particular direction. The second law of thermodynamics contradicted this, Prigogine and Stengers claim, because it stated that the universe was running down - energy available for work was inevitably being dissipated, entropy was always increasing, and the universe was moving towards 'heat death.' This gave an arrow to time, suggesting a very important sense in which time was not reversible (this was such an important insight to C.P. Snow that, during the two-cultures debate, he suggested that it should be as central to our culture as the works of Shakespeare).¹⁶ This inexorable move towards heat death constitutes a crisis in the Newtonian paradigm because it contradicts one of its basic tenets (that time is reversible).

However, a more common period to assume the role of providing a crisis in Enlightenment science is the early twentieth century. Narratives favouring this option focus on Einstein's theories of relativity and quantum physics, regarding them separately, or linking the two together. This is where the second complication in this phase of the scientific discourse occurs, because either or both of these can also be seen to be closely linked to the first or third phases.

Einstein's theories of relativity are perceived to be important because they call into question Newtonian notions of absolute time and absolute space. For Newton, time and space were separate entities - space was an absolute, unchanging area in which things existed, and time provided an idealised measure against which the change of things within that space could be charted. However, the notion of spacetime (rather than space and time) which emerged after the publication of Einstein's special theory of relativity in 1905, and his general theory of relativity in 1915, makes space and time dependent upon one another. Neither can be taken as an

¹⁶C.P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge UP, 1959) 14.

absolute entity through which material reality moves because both are warped by the distribution of mass and energy within them.

The core literature/science discourse suggests that these constitute a crisis by setting up the Einsteinian notion of reality in direct opposition to the Newtonian one. For example, Adalaide Morris presents a view of a three-stage crisis in the Newtonian paradigm: relativity destroys the idea of absolute space and time, quantum physics destroys the possibility of exact measurements, and chaos theory finishes off the idea of the universe as predictable and determined. Because it is only with the last of these that the old Newtonian paradigm is finally dead and buried, the other two must take on the status of crises in, rather than complete renunciations of, Newtonianism: 'if relativity eliminated the Newtonian illusion of absolute space and time and quantum theory ended the Newtonian dream of precise, controllable measurements, chaos puts a definitive stop to the idea that the course of the universe is both determined and predictable.'¹⁷ For Morris, therefore, however revolutionary relativity and quantum theory seemed, only chaos theory puts a 'definitive stop' to Newtonianism, finally banishing its remaining tenets. The rhetorical effect of this sentence is to situate relativity and quantum theory as 'modernist' moments in Enlightenment science, making chaos theory the moment of transition to a wholly 'postmodern' (in my use of the term) view of reality.

However, this period can also be read into the first or third phases of the discourse. For instance, Eric White argues that Einstein shared the Newtonian 'aversion to temporality,' and so although his theories might have laid the basis for the renunciation of the old certainties, Einstein himself might thus be regarded as 'the last classical physicist.'¹⁸ Ian Stewart seems to make a similar point by titling his popularisation of chaos theory, *Does God Play Dice?* The phrase originates in Einstein's oft-quoted suggestion that the conclusions implied by quantum physics could not be right because 'God does not play dice' - everything is determined, as the Newtonian paradigm suggests. However, Stewart's book offers a resounding 'yes' (God does, in some sense, play dice) response to the question posed in the title. He therefore distances himself and chaos theory from Einstein, who is consequently identified with a previous scientific paradigm. These sorts of narratives therefore suggest that we could place Einstein at the tail end of the first phase of the discourse, rather than in the second phase.

However, he is also sometimes placed in the third phase. For instance, although White's reading suggests that Einstein himself might have been committed

¹⁷Morris 211.

¹⁸Eric White, 'Contemporary Cosmology and Narrative Theory,' *Literature and Science: Theory and Practice*, ed. Stuart Peterfreund (Boston: Northeastern UP, 1990) 103-04.

to a Newtonian paradigm (as the 'last classical physicist'), the article implies that Einstein's ideas are actually part of a new paradigm, reacting against Newtonianism. Although in some senses this makes it, in my terms, a modernist science (rather than realist), it can also be seen as postmodernist by suggesting that reality is the product of the observer's dialectical interaction with the universe that he or she observes.

Quantum physics occupies a similarly indeterminate position in the three-part movement from Enlightenment to postmodern. It fits most naturally into the second phase by mirroring, in its popular presentations, Wallace Stevens' emphasis upon the subject who makes observations about reality. The most oft-quoted (and some would say misquoted) formulation in the canon of quantum physics is the uncertainty principle, proposed by Werner Heisenberg whom I quoted near the beginning of this chapter. In its popularised forms, this states that at the subatomic level it is never possible to know both the position and the velocity of a particle because the means we use to measure one will alter the value of the other. This implicates us in the systems that we study, because the choices that we make about what to look for will determine what we eventually see. What we perceive as reality is therefore always mediated through the choices made by the observer, and we cannot maintain the Newtonian and Cartesian emphasis upon an entirely rational and objective onlooker.¹⁹

However, like relativity, quantum physics' location within the second phase of the discourse is not absolutely certain, and it is sometimes read as being part of the third, postmodern phase of the scientific narrative. This involves pushing its philosophical consequences further and seeing it as an interrogation of the whole basis of reality, not just the isolation of a vision of reality in the observer's mind.

This illustrates the more uncertain nature of the 'modernist' crisis in the scientific strand of the literature/science discourse. This may be a result of the distinctive disciplinary traditions and subject matter of science, which associate it with certainty and demand a commitment to a more sustained notion of truth than is required by literature. If this is the case then science's inability to tolerate long periods of crisis would be the explanation for the more insubstantial, and less widely agreed, second phase of the developing scientific discourse.

Nevertheless, the basic structure of a move from realism to postmodernism is not often subverted. Although the specific terms that I am using (*realist*, *modernist*, and *postmodernist*) might not be favoured by all critics, or even recognised by most scientists, the basic elements in the shifts from Enlightenment to contemporary science are often presented in the general framework that I have identified. The

¹⁹But see David Porush, 'Eudoxical Discourse: A Post-Postmodern Model for the Relations Between Science and Literature,' *Modern Language Studies* 20.4 (1990): 40-64. Porush rightly points out that many literary critics have misread Heisenberg's uncertainty principle to mean that science cannot describe reality on any level at all.

second element in this framework, discussed here, is of relatively peripheral interest. The important difference is that between early science and present-day science, which I will explore through the construction of chaos theory as a 'revolutionary' science in subsequent chapters.

Formalism and Structuralism

As the quotation from Terence Hawkes in the introductory pages to this chapter indicates, literary theory participates in the shift in the notion of reality that I have already identified in literature and science, and formalism and structuralism are active agents in the second phase of the core literature/science discourse. Perhaps the most characteristic development, from the work of the New Critics, is an increased emphasis upon the desire to emulate science. The New Criticism aimed for objective judgements of literature, but formalism and structuralism go much further in trying to establish a level of detachment from literature, emulating that that the scientist is supposed to achieve from nature.

However, unlike the New Critics, formalists and structuralists do not set up literary criticism in opposition to science, balancing two distinct halves of the culture, but instead make the claim that they are themselves involved in scientific activity. For example, Roman Jakobson, Roland Barthes and Terence Hawkes all claim that structuralism (or at least, what we now think of as structuralism, whatever name it went under originally), is a 'science' of forms, signs or language.²⁰ Indeed, Jakobson comes to literature from linguistics, an academic discipline which claims parity with the sciences and whose project he describes as 'the typological comparison of languages and . . . the quest for ordered laws which underlie this typology and govern all languages of the world. . . .'²¹ The concept of 'ordered laws' (note, again, the importance of order to this phase of the core literature/science discourse) resonates with the certainty associated with scientific 'laws' of nature. Justifiably, then, Jakobson's influence in literary-critical circles can be seen as evidence of a desire to speak about literature with the same certainty that scientists speak (or are perceived to speak) about nature.

A pertinent example of this new scientific spirit in literary theory, can be found in a description that Hawkes gives of an analysis of literary innovation proffered by Victor Shklovsky: Shklovsky produced a "law" [which] implies that all

²⁰Hawkes 158. Roland Barthes, *Mythologies*, trans. Annette Lavers (1957; London: Vintage, 1993) 111. Roman Jakobson, *Main Trends in the Science of Language* (1973; New York: Harper and Row, 1974) title.

²¹Jakobson 24.

art exists in a continuum, that “high” art periodically shifts its boundaries within that continuum in order to renew itself, and that the only constant in this process is the sense which “literature” must always manifest, of being “literary”.²² This law fulfils a key function of a scientific law, albeit to a limited degree: that it be able to make predictions which can be tested against experience.

This talk of the study of language and literature as a science, involves a separation between the objective critic and the object of literary study, between observer and observed, which is actually similar to that preached by Richards and Descartes. Literature is a definable object, residing in a stable, objectively verifiable text (like the New Critics, the formalists and structuralists focus exclusively on the text itself). As a result, it can be approached in a scientific manner. In this respect one thinks particularly of the Russian Formalist notion of ‘literariness,’ of Vladimir Propp’s classification of the features shared by all Russian folktales, of Jakobson’s sharp division between the metonymical and metaphorical axes of language, and of Barthes’s analyses of the principles underlying modern myths. All focus on aspects of literature which are assumed to have a definite, objective existence.

However, despite supposing an objectivity in the critic equivalent to that called for by Richards, and despite supposing that literature (though not necessarily Literature) is an object which has a stable, describable existence, they are marked by two crucial differences to the approach of the New Critics. Firstly, they find meaning not in the individual text (in its message), but in more universal structures which generate individual textual phenomena. These structures are generally, though not exclusively, assumed to be social or cultural in origin. Formalist and structuralist approaches attempt to define the principles that underlie and generate stable textual objects, just as the classical scientific method analyses and deduces the laws underlying stable material phenomena.

Secondly, they do away with the principle of ‘value,’ which was fundamental to Richards’ approach to literature. Literature as something which is ‘good’ for the reader is not a concern of the formalists and structuralists; rather than being concerned with the ‘what’ of literature (‘what does it say?’ ‘what is it good for?’), they are more concerned with the ‘how’ (‘how does it come about?’ ‘how does it have an effect?’).

The many forms of formalism and structuralism all share the concerns described above. Formalists tend to concern themselves with classifying the elements which define a given concept (*literariness*, *Russian folk-tale*, etc.), while structuralists try to further this project by concentrating more explicitly upon the deep-lying

²²Hawkes 72. The essence of Shklovsky’s ideas can be gleaned from his 1917 essay, ‘Art as Technique,’ Lemon and Reis 3-24.

structures that generate these forms, but they are roughly equivalent in that they share a certain orientation towards the literary object of study. So these shifts, away from the New Critical approach, also involve a move towards a more scientific approach to literature.

Two crucial aspirations tie structuralism to science: a desire to deny that the object of study has a value, endowing it with an existence independent of the individual observer (this is ironic, given the links between subject and object being articulated by Heisenberg and some other scientists during this phase of the discourse); and a desire to produce statements about the object of study that manifest a high degree of certainty and objectivity. Because this new orientation does away with the value-judgement of literature, which was so important to the (now mis-named) New Criticism, and because it aspires to a scientific methodology, following from it is a significant re-articulation of the relative positions of literature and science within the culture. Most crucially, the simplistic Arts/Sciences division, which I found to be prevalent in the first phase of the discourse, begins to be contested.

On the one hand, this division is complicated by the assertion I have already alluded to, that literary criticism and science are of equal value. Jakobson goes even further, suggesting that the study of language provides a common link between all of the human sciences: 'The problem of the interrelation between the sciences of man appears to be centred upon linguistics. . . . [L]inguistics is recognized both by anthropologists and psychologists as the most progressive and precise among the sciences of man and, hence, as a methodological model for the remainder of those disciplines.'²³

On the other hand, and much more importantly, by complicating the Arts/Sciences division, formalism and structuralism suggest, for the first time, that literary critics can talk about literature and science as equivalent activities. Once we accept the structuralist notion that individual utterances are generated by deep cultural and linguistic structures, and are not objective, unproblematic articulations of pre-existent concepts, then we can see how seemingly separate literary and scientific voices are generated by shared cultural structures. We begin to move then, towards a view of literature and science which I drew upon in the introduction: literature and science as culturally determined discourses.

That the possibility of a mature literature/science criticism that this offers, did not emerge until very recently, may be explained by the fact that formalist and structuralist criticism did not profoundly affect the Anglo-American academy until the 1960s (for instance, key Russian Formalist work did not appear in English translation until Lemon and Reis's translation of key essays in 1965). Key

²³Jakobson 26.

innovations - particularly the publication of Ferdinand de Saussure's *Course in General Linguistics* - occurred roughly in step with the second phase of the scientific and literary strands of the discourse, in the early years of the century, but did not necessarily have an immediate, world-wide impact.

Brief reference to a Roland Barthes's essay 'Myth Today,' which closes the selection of articles in *Mythologies*, will illustrate how much more suggestive structuralism is for literature/science criticism than were the works of the New Critics. Barthes defines myth as a 'second-order semiological system,' which takes the sign of an ordinary system as its signifier, and then generates meaning by overlaying it with further significance. In other words a myth 'means' in two ways: one is the literal meaning; the other is the 'deeper' significance which is attached to that meaning.

This is highly suggestive for an understanding of the cultural impact of science. Any scientific concept or theory has a literal meaning - the thing that it directly describes. However, attached to this may be a whole series of mythical meanings, which penetrate the public consciousness. For instance, the second law of thermodynamics literally refers to the tendency of a closed system to increase in entropy. However, on top of this are a whole series of other meanings, revolving around the threat that chaos poses to order. It is this sense of science as myth which I am invoking in this thesis. In the second section (chapters five, six and seven) I shall be exploring some of the contemporary myths constructed by literature and science writing.

However, the fundamental characteristic of formalist and structuralist approaches to literature for our current purposes (for an understanding of the development of the second phase of the literature/science discourse) lies in their approach to reality. We can no longer find reality in discrete essences, but must focus on the relationships between things, the structures which produce them. In this sense the notion of reality as the ordered existence of a divinely created world has vanished, and reality without an observer (or a structure in the mind of an observer) can only be thought of as chaos. In this sense, structuralism is part of the same crisis in the Enlightenment world-view which we found in literature and science.

However, despite the apparent threat of chaos, order is rescued by the reinscription of reality into the mind of the observer. We might not be able to conceive of an objective reality, in any knowable sense, without an observer, but by focusing on how reality is perceived we can find it elsewhere. So although there is an (at least implicit) admission that the world is chaotic, certain mental and cultural structures - certain ways of perceiving - produce order. This ties in with the use of myth to structure chaotic contemporary experiences in some modernist literature, most notably James Joyce's *Ulysses* and T.S. Eliot's 'The Waste Land.' The

structuralists also aspire to an ordering of the chaotic. This ordering is enabled because they deem it possible to employ a metalanguage to describe how the semiological systems with which we see the world function.

It is the challenging of this retention of the notion of order which is the next significant development, taking us as it does into the third phase of the core literature/science discourse, and into the postmodern.

Chapter Three

The Third Phase of the Core Literature/Science Discourse: Postmodernism / Chaos Theory / Poststructuralism

The three narrative strands in this phase of the discourse are linked - despite some individual differences - by the sustained assault they launch upon preconceptions embedded in Enlightenment views of knowledge. In other words they take issue with the principles underpinning first-phase epistemologies which I analysed in chapter one. In this respect they mirror the 'crisis' character of the second-phase discourses with which chapter two dealt, but depart from them, at least partially, in the degree to which they reject Enlightenment viewpoints, and in their attempt to develop radically new ways of articulating knowledge. Second-phase discourses came up against the limits of Enlightenment epistemologies; third-phase discourses push beyond those limits and explore the consequences of rejecting preconceptions about knowledge which have functioned for so long in Western society.

The potency of this rejection varies between each strand of the discourse, but in general it takes the form of an interrogation of the three main components of Enlightenment approaches to knowledge: the *subject* who 'knows' the knowledge; the *object* which he or she knows; and the *discourse* which is used to articulate that knowledge. In at least two strands of the discourse (literature and literary theory, but not so obviously in science), this interrogation leads to a conception of knowledge, and of the 'knowing subject,' homologous with that articulated by Lyotard (and quoted on pages thirteen and fourteen). I will begin with the literary strand as this is the one which most conveniently fits the model I have just described.

Postmodernism

I have already shown how the straightforward Enlightenment distinction between subject and object was manifested in the realist literary tradition by its tacit supposition that a widely shared reality exists. The implication of this distinction is similar to that of the Cartesian split between body and mind. By separating the mind from the treacherous deficiencies of bodily senses, Descartes supposed a rational subject who could think objectively about the object of his or her enquiry.

This was called into question in the second, modernist phase of the discourse. For example, I showed how the development of stream-of-consciousness narratives can be read as indicative of a growing perception that reality is not universally shared between subjects, but is refracted differently through each subject's perceptions.

Postmodern literature further reconfigures the relationship between subject and object by making it much more dynamic. Instead of a passive emphasis, upon reality being reflected differently for different subjects, it embraces a more active dialectic, with different subjects constructing reality in different ways. Furthermore, postmodern literature implicates the reader in this process of reality construction to a greater degree than modernist literature. We can see how this comes about if we focus separately upon subject, object and discourse.¹

A forerunner of postmodernist literature, Joseph Heller's *Catch-22*, provides a good illustration of the way in which the independent existence and status of the object is called into question by literature in this phase of the discourse. At first there seems to be little which is postmodern about this novel. Although constant disruptions of narrative sequence indicate a questioning of realist form, and the nightmare military bureaucracy recalls Kafka's modernist concerns, the novel is still a long way from the experimental fiction of Thomas Pynchon and John Barth.

However, one crucial passage towards the end of the novel means that it is best understood as an early example of what would later develop into postmodernism. This is the moment of epiphany when Yossarian realises that *Catch-22*, which has blighted his life for so long, does not even exist: 'Catch-22 did not exist, he was positive of that, but it made no difference. What did matter was that everyone thought it existed, and that was much worse, for there was no object or text to ridicule or refute, to accuse, criticize, attack, amend, hate, revile, spit at, rip to shreds, trample upon or burn up.'²

Catch-22 has been the main object of the narrative and of Yossarian's attention. It has frustrated him at every turn and has, most crucially, prevented him from claiming insanity in order to escape the air force (because the only way out is to claim insanity, but to claim insanity is to demonstrate that he fully appreciates the dangers of combat, and that he is therefore of sound mind). Before Yossarian's moment of insight, *Catch-22* is assumed to exist as a loop-hole exploited by the military bureaucracy in order to control Yossarian and his comrades, and to prevent them from threatening the military hierarchy.

As soon as we realise that it does not exist, however, our reading of the novel must change in a significant way. The lives, actions and deaths of the characters have been generated by an object that has no reality beyond people's perceptions of it. *Catch-22* is an assumed reality, a chimera invoked in power struggles between the military and individuals, in order to maintain the status quo. It has no originating moment, and no character is identified as inventing it - it is just 'there,' an absent centre

¹I here mean *discourse* in the sense of the language used by the subject to comprehend and articulate the object.

²Joseph Heller, *Catch-22* (1961; London: Corgi, 1974) 516.

around which the hierarchy of the military is constructed, and which keeps everyone, from top to bottom, in their places. There is therefore no really-existing object (*Catch-22*) for the subject (Yossarian) to comprehend.

This is reiterated by other events in the novel, particularly those in which image and reality become confused, and in which reality is transformed by manipulations, not of itself, but of images of it. A prime example is that of the bomb line on a map, an image which represents the extent of the allied advance up the Italian peninsula. The airmen become obsessed with this, willing it to move up far enough to prevent them having to undertake the perilous bombing mission over Bologna. Clevinger is amazed by their irrational assumption that the reality of the forthcoming mission can in any way be affected by this visual image of it: 'I really can't believe it They're confusing cause and effect They really believe that we wouldn't have to fly that mission tomorrow if someone would only tiptoe up to the map in the middle of the night and move the bomb line over Bologna. Can you imagine? You and I must be the only rational ones left.'³

It is significant that Clevinger claims to speak for rationalism, and believes in straightforward cause and effect, because this equates him with a commonsensical view of the world similar to that I identified with the Enlightenment. The naïveté of Clevinger's view is demonstrated when Yossarian does tiptoe up to the map in the middle of the night, move the bomb line over Bologna, and manage to get the mission postponed. The image, the bomb line on the map, does not just reflect the reality it represents, it has repercussions which reverberate out into the real world, affecting the bombing mission.

The consequences of this assault upon traditional notions of reality are not pursued as far as they are in later postmodernist texts. This is because *Catch-22* offers a hope, however remote, that the irrational world which it represents can be escaped - flight to Sweden offers the possibility of evading the mad world of war at the end of the novel. It suggests that the world of the novel is an aberration which will be recognised as such by the reader, and holds out the hope of a return to a more rational world where bureaucratic constructions like *Catch-22* do not hold the status of reality.

Additionally, although *Catch-22* shows the object of articulations of the world (reality) to be departing from that assumed by Enlightenment discourses, it does not interrogate the subject (the person who knows that world) in quite the same way. Yossarian represents a sane, stable vision of the world (a voice speaking against its insanity), and the reader is asked to identify with him and to adopt the same attitude. However, many later postmodernist novels do begin to interrogate the notion of the

³Heller 156.

subject, and a typical example of this appears in Thomas Pynchon's *The Crying of Lot 49*.

The subject in the novel, Oedipa Maas, is faced with a situation similar to that which confronts Yossarian in *Catch-22*: a world which does not function according to the rational logic of realist fiction, and which is held together by a mysterious central motif, the Trystero (which is rather like *Catch-22*, but has an even more uncertain existence, manifesting itself in various enigmatic guises, and even under different spellings). As in Heller's novel, this object of knowledge is interrogated by the subject, with Oedipa taking on the role of detective and searching for information about the Trystero. Just as *Catch-22* is eventually shown not to exist, so Oedipa is left at the end of the novel, uncertain whether the Trystero really exists, whether it is all an elaborate hoax developed to deceive her, or whether it is the product of her paranoid imagination.⁴

However, it is not only this 'object of knowledge' that is interrogated by the novel. The Enlightenment conception of the subject is also drawn into question by the presentation of Oedipa herself. Although she is undoubtedly the major protagonist, she is not fleshed out and provided with the psychological motivations that we would expect to drive the actions of a main character. Conversely, minor characters are introduced with synopses of their lives which do not function in the plot and which do not serve to illuminate their characters as we might expect. Oedipa's status (and that of the other subjects in the text) is therefore very different to that of the protagonist of realist fiction, where the goal is to create unified, fully-rounded subjects. Unlike Yossarian, who is given a psychological core that serves to explain his actions (it is gradually revealed to the reader that Snowden's death has had a profound effect upon him), Oedipa merely takes us through the novel, perhaps motivated by curiosity, but lacking a real history or a unified subjectivity which can be adequately explained in realist terms.

Indeed, she is very like the subject posited by Lyotard in the passage that I quoted on pages thirteen and fourteen. She is a 'node' in an information circuit - or rather, a series of information circuits - positioned by the various manifestations of the Trystero and the information she receives about it. Pynchon broadens his attack on the traditional view of the subject in a later work, *Gravity's Rainbow*. Like Oedipa, the central character in this novel, Slothrop, is on a quest for information (to explain why the V-2 rocket strikes on London exactly correlate with his own erections). By the end of the novel he is not only left in a state of confusion like Oedipa, but has literally fragmented, scattering all over Europe.

Crucially, he is shown to be not only a subject seeking after knowledge, but also an object of knowledge, pursued and studied by various military and government

⁴Thomas Pynchon, *The Crying of Lot 49* (1966; London: Picador-Pan, 1979) 123-24.

agencies, as well as various individual characters who have a personal interest in him. His final fragmentation is perhaps an allegorical working out of the incompatibility of the different views of him, and of the different roles and identities he is forced to adopt in the course of the novel, as his identity comes under attack from the various objectifications of him. In neither *The Crying of Lot 49*, nor *Gravity's Rainbow*, is there an isolated subject who can be divorced from the knowledge which he or she seeks to attain. The latter novel, in particular, complicates the straightforward subject/object schism.

In questioning the subject/object relationship intrinsic to the Enlightenment, Pynchon also elaborates a new style of discourse. A key element of this is the superabundance of information which faces both Oedipa and the reader. As Bernhard Dufhuizen argues, Oedipa 'comes to embody the postmodern condition of information overload - like a reader of postmodern fiction . . . [she] cannot keep all of the fragments together in one totalized story.'⁵ What leads to the overwhelming volume of information that threatens Oedipa is her inability to distinguish between that which is meaningful and that which is redundant. All the information seems to carry equal weight and it is hard to sort out that which is relevant from that which is not.

As readers we are also effectively implicated in this process. Like Oedipa, we are presented with a wealth of unhierarchized information - for instance, a large number of characters are introduced with details about them which are of doubtful relevance to the text, and which do not function to elaborate the central story involving Oedipa. Like her, we are engaged in what is essentially a detective novel, trying to find the clues to explain what happens. However, there is no comforting resolution as there is in traditional detective fictions, where the truth of the matter is discovered and it is possible, at least retrospectively, to find out what was and was not of importance. Hence, at the end of the novel, we are left in a more complicated and confused situation than we were at the beginning - clues have proliferated and the links between them multiplied exponentially. Like Oedipa, we do not know whether the Trystero exists, whether it is a hoax, or whether it, and the other links we have made between the bits of information which constitute the text, are the products of a paranoid imagination.

By employing this sort of technique, Pynchon succeeds in implicating the reader in a style of discourse that departs from that favoured by Enlightenment narratives. His novels do not only interrogate the positions of subject and object within the text (Oedipa's attempts to understand the Trystero), but they also make this an extra-textual issue (with the reader, as subject, trying to make sense of the text, as object). The reader has to be much more active in relation to postmodern literature than to realist

⁵Bernhard Dufhuizen, "'Hushing Sick Transmissions': Disrupting Story in *The Crying of Lot 49*," *New Essays on The Crying of Lot 49*, ed. Patrick O'Donnell (Cambridge: Cambridge UP, 1991) 88.

literature, and Pynchon's novels draw attention to the role readers play in constructing not only postmodernist texts, but also all texts.

So, to the extent that Pynchon's novels are typical of postmodern literature, it is reasonable to suggest that postmodernist texts offer a radically different view of legitimation and knowledge than earlier literature. In terms of the game metaphor which I used to describe the reader's relation to the author for realist and modernist literature in chapters one and two, postmodern literature denotes a game where the limits and boundaries of the game are themselves under question from, and constituted by, the reader. In other words, the relationship between reader and text is much more dynamic.

Conversely, the model of reading which follows from realist literature is one which follows quite naturally from a Cartesian split between mind and body and, by implication, between subject and object. Meaning is constrained because the information is organised in such a way as to limit the readings available to the reader. Hence the reader, as subject, approaches the text, as object, and will read it in a way which has been heavily constrained by the author (all the information conspires to account for protagonists and their actions in a few very limited ways). In this respect, it is reasonable to talk of the reading subject as split from the textual object in realist literature - different readers will produce fairly similar readings.⁶ However, postmodern literature blurs this distinction by making the flow of information two-way - not just from text to reader, but from reader back to text as the reader tries to process the information. This also serves, of course, to draw attention to the way in which even in realist literature there must be this two-way flow of information, and we must construct the text as we read it.

We can say, therefore, that the reader assumed by postmodern literature is identifiable with the 'knowing subject' proposed by Lyotard. He or she is not just a receiver of information, but a point in a series of information circuits, traversed by various pieces of information, positioned by them, and indeed positioning them. The reader is not outside looking in at literature, but participates in a world which is partially constituted by the texts which he or she reads, and the readings which he or she produces of them.

Legitimation is therefore achieved by a process of active interpretation and feedback between subject and object. To see the degree to which this postmodern world-view is manifested in science we must now turn to a consideration of quantum physics and chaos theory.

⁶Perhaps texts which assume this straightforward split between reader and text also presuppose a critical approach similar to that of I.A. Richards, in which it is the job of the literary critic to identify the 'correct' reading, and hence banish all uncertainty from the relationship between subject and object. I comment further upon this issue on page eighty-seven.

Quantum Physics and Chaos Theory

In chapter two I commented that quantum physics is sometimes read as being a part of the third phase of the scientific strand of the core literature/science discourse rather than the second. This reading emphasises that not only do we only see what we look for, but also that what we look at is changed by the very action of looking. In this respect, it involves a more rigorous dialectic between subject and object than previous phases of the science strand of the discourse. Examples of the sorts of statement that can lead to this slightly more radical reading of quantum theory, and particularly of Heisenberg's uncertainty principle, might be Isaac Asimov's contention that in 'the very act of measuring its [an electron's] position, we would have changed that position';⁷ and Bryan Appleyard's suggestion that Heisenberg showed that it 'was not simply that we could not know these facts [about the velocity and position of a sub-atomic particle], it was rather that *they could not be known*.'⁸

However, a more frequently cited example of a 'postmodern' science is chaos theory. This does not so obviously call into question the subject/object dichotomy because, while the information the subject can have about any given chaotic system is shown to be fundamentally limited, it is not necessarily suggested that the subject is implicated in the system which he or she studies. However, it is postmodern in a different way.

Chaos theory (or perhaps theories, as this is a catch-all term for a series of fairly loosely linked scientific developments) is strongly associated with what is termed 'sensitive dependence on initial conditions.' What this suggests is that a chaotic system will develop in a radically different way if the initial starting conditions are only altered very slightly. This is often illustrated by reference to the weather which, as a chaotic system, is subject to very slight fluctuations within the system. The so-called 'butterfly effect' has become a cliché of attempts to explain chaos theory: the weather is so sensitive to minor fluctuations that if a butterfly flaps its wings in Tokyo, a hurricane may hit New York which would not otherwise have done so.⁹ The place names change

⁷Isaac Asimov, *Asimov's New Guide to Science* (1984; London: Penguin, 1987) 376.

⁸Bryan Appleyard, *Understanding the Present: Science and the Soul of Modern Man*, 2nd ed. (1992; London: Picador-Pan, 1993) 158.

⁹See, for example, the following passages for references to the butterfly effect: Appleyard 161-62; Gleick 8; Davies and Gribbin 34-35; David Ruelle, *Chance and Chaos* (1991; London: Penguin, 1993) 74; Ian Stewart, *Does God Play Dice? The Mathematics of Chaos* (1989; London: Penguin, 1990) 141. An interesting literary forerunner to the butterfly effect comes in Ray Bradbury's short story, 'A Sound of Thunder,' in which time-travelling tourists completely change the course of history when they inadvertently kill a prehistoric butterfly. Ray Bradbury, 'A Sound of Thunder,' *Ray Bradbury, The Pegasus Library* (London: Harrap, 1975) 69-84. Harriett Hawkins points out that Edward Lorenz, who first formulated the butterfly effect (see my discussion in chapter five), was reminded of Bradbury's story by colleagues after he had written and presented his paper on the phenomenon. Harriett Hawkins, *Strange Attractors: Literature and Chaos Theory* (New York: Prentice-Harvester Wheatsheaf, 1995) 2.

as the butterfly analogy gets retold (Appleyard's Tokyo butterfly disrupts Chicago; Gleick's Peking butterfly ruins the New York weather; and, rather more parochially, Davies and Gribbin's Adelaide butterfly has an unstated effect upon Sussex - quite why cabbage whites in Britain or America never ruin Southern Hemisphere weather remains a mystery), but the effects are always deemed to be violent, perhaps to illustrate the importance of chaotic systems to our lives. Strangely, no one bothers to point out that a butterfly flapping its wings in Tokyo can result in New York suffering a light breeze with scattered showers moving in from the west.

However, although the butterfly effect suggests a degree of randomness which is beyond prediction and control, chaos theory has enabled the elaboration of various ways of mapping and describing these chaotic systems. These descriptions do not function in quite the same way as traditional scientific descriptions because they do not predict exactly what will happen to a chaotic system, and they are not derived by reducing problems to their constituent units. Instead, they look at problems on a larger scale and predict the parameters within which the 'random' elements within the system will work. What chaos theory has uncovered therefore is a region between order and disorder.

Classical science applied itself to ordered, linear systems (where small causes give rise to small effects, and large causes to large effects), and everything which could not be described by the laws which were found to govern these systems was assumed to function in a random, disordered manner (or, at least, it was thought that the ordered laws which governed it had not yet been found or were too complex to formulate). By applying itself to nonlinear systems, chaos theory produces a strange mixture of order and disorder, opening up a territory which lies somewhere between the two. *Chaos* is therefore redefined by chaos theory as that which is neither ordered nor disordered, but in a strange region in between. It can be described, but there are limits to how much we can know about such a system and to what degree we can control it.

In *Chaos* James Gleick argues that it constitutes a fundamentally different way of doing science, and is indeed revolutionary, because it shows us that the universe is not comprised of ordered, linear systems, but is predominantly populated by these nonlinear systems.¹⁰ When seen in the context of the core literature/science discourse these sorts of statements seem to endow chaos theory with postmodern characteristics.

N. Katherine Hayles' *Chaos Bound* is a convincing example of the sort of argument which enables chaos theory to be seen in this way. Although she does not

¹⁰Gleick cites Thomas Kuhn's model of scientific progress in which knowledge is not steadily accumulated, but proceeds by 'revolution,' with the successive overturning of a series of world-views. Gleick, *Chaos* 35-39. See also Kuhn, referenced above. I will explore this issue in more detail in chapters four and five.

concentrate on Gleick, and claims that he ignores some significant elements of chaos theory, she too sees it as an opening-up of territory between order and disorder, destabilising the binary distinction between the two which has for so long been fundamental to Western culture, and signifying the development of a significant fault line in the episteme.¹¹ In subverting this binary distinction, chaos theory also undermines the strict opposition between global and local because it suggests that effects on a small, local scale (the flapping of a butterfly's wings) can be magnified up through to higher scales (global weather conditions) in a very short time. I explore this in greater detail in chapter five, where I draw out the ways in which chaos theory and postmodern literature mine the order/disorder and global/local fault lines in the culture.

Whilst saying this, it is important not to overestimate the revolutionary impact of chaos theory and quantum physics. They do seem to challenge certain scientific and cultural assumptions, but do not necessarily involve a completely new way of doing science - as Kenneth Knoespel comments, '[w]hat chaos theory and the uncertainty principle share more than anything else is the sophisticated extension of mathematics within carefully controlled parameters.'¹² However, although the links between these twentieth-century sciences and traditional science must not be forgotten, the ways in which they are presented in our culture do emphasise different things to classical science: unpredictability and openness over predictability and determinism, in the case of chaos theory, and the inevitability of subjective rather than objective observation, in the case of quantum physics.

It is fair to say, then, that the concept of reality postulated by the sciences has shifted: reality is no longer assumed to be wholly knowable or wholly determined. As a result we cannot speak from the same position of certainty as we previously did. Hence, while the interrogation of Enlightenment visions of reality by contemporary science might not be as great as it is in the case of contemporary literature (perhaps because of the different disciplinary traditions from which each comes, and the resultant demand that science speak the Truth), it is certainly markedly different to previous discourses about reality. We might trust the discourses that our sciences speak to tell the truth, but we know that the truth which they speak is fundamentally limited.

Therefore, as with postmodern literature, our attention is drawn to the discourses that produce images of the world, and which can never wholly match the reality they attempt to describe. As with the literary strand therefore, the fundamental faith upon which a belief in reality is based (the faith that narratives can objectively

¹¹Hayles, *Chaos Bound* 16. I discuss this in more detail in chapter five, and quote Hayles' consideration of this issue on page 121.

¹²Kenneth J. Knoespel, 'The Emplotment of Chaos: Instability and Narrative Order,' *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles (Chicago: U of Chicago P, 1991) 104. The significance of chaos theory is also disputed within the scientific community.

speak reality in its totality) has been eroded, and the optimism of Descartes and Laplace has been superseded by a greater scepticism. Perhaps the most radical erosion of this faith in the possibility of speaking reality comes from literary theory's most recent manifestation: poststructuralism.

Poststructuralism

As we saw in the last chapter, structuralism distanced itself from previous critical approaches to literature by setting itself up as a scientific investigation of the signifying systems that constitute literary and other texts. Poststructuralism is distanced, in turn, from structuralism by attacking the scientific status which it assumes. For example, Raman Selden and Peter Widdowson comment that poststructuralism tries to 'deflate the scientific pretensions of structuralism,'¹³ and Robert Young suggests that poststructuralism's assault on structuralism has 'questioned the status of science itself. . .'¹⁴ We might say therefore that the attack on structuralism comes in two, related guises.

The first launches an assault on the possibility of producing a 'science' of literature; the second attempts to deflate the pretensions to truth of science itself. I will focus on this two-pronged attack because it allows us to chart the move from structuralism, and in the process of doing this to define poststructuralism (which is, in any case, best identified in terms of its differences from structuralism, rather than by virtue of any 'essence' which is typical of it). As with the other strands of the discourse, it is useful to break down poststructuralism's assault on previous viewpoints into separate attacks on object, subject and discourse, and deal with each separately.

If we start with the object of literary study - literature itself - we can see this quite clearly. Structuralism assumes, according to Young, that 'meaning and signification are both transparent and already in place. . .'¹⁵ In other words meaning, and the communication of it, are assumed to be embedded in the work of literature before it is read. This gives it the status of an observed object similar to that supposed by Descartes - the object exists independently of any observation of it, and the critic has only to come along and find the meaning. The problem with this view, for the poststructuralists, is that meaning cannot be assumed to exist without someone to impart

¹³Raman Selden and Peter Widdowson, *A Reader's Guide to Contemporary Literary Theory*, 3rd ed. (New York: Harvester Wheatsheaf, 1993) 125.

¹⁴Robert Young, preface, *Untying the Text: A Post-Structuralist Reader*, ed. Young (Boston: Routledge, 1981) vii.

¹⁵Young 3.

that meaning - meaning comes from the observer's or reader's conferral of meaning upon the text.

Not only is this object supposed to pre-exist the reader's approach to it, but it is supposed by structuralism to be harmonious and unified - each part of the structure contributes to the working of the whole. Young paraphrases Pierre Macherey's critique of structuralism in this respect: 'structuralism presupposes the traditional and metaphysical notion of harmony and unity: a work only exists in so far as it realises a totality. Hence structuralism presupposes a "theology of creation". The organic structure, of interdependent parts creating a whole, is only a variant on causal teleology.'¹⁶ When described in these terms, the structure supposed by structuralists to underlie all utterances sounds very similar to the model of the material world presupposed by Newtonian science and analysed in chapter one: a linear universe in which the workings of the whole are exactly equivalent to the workings of the parts. This again indicates the remarkable degree of equivalence between the supposedly isolated cultures of literature and science, with poststructuralism's rejection of unity and harmony mirroring the move away from a Newtonian world-view in the sciences (although it is a more radical departure to that undertaken by the sciences). Poststructuralists oppose the view that the object of study is harmonious and unified by showing the instability of all narratives, and the ways in which they transcend the limitations which they set themselves - one thinks particularly of Jacques Derrida's deconstructive practices in this respect.

These assaults on the object of study do not just apply to specific texts, but also to notions of literary history. A poststructuralist approach would argue that not only does a harmonious meaning not pre-exist in individual texts, but that our views of literary history as a steady development, encompassing all literary texts in an onward movement, are also flawed and based on a false and historically-specific desire to find a teleologically-inclined order in the world.

This obviously seems to conflict with my basic project, which is founded on the argument that there has been a roughly synchronous development in literature, science and literary theory over the past three-hundred years. I will deal with this objection in greater detail in the next chapter, and in the introduction to Section Two, when I come to consider my own theoretical position against the background of the historical development I have outlined, but suffice it to say for now that I have two defences against this possible objection. Firstly, as I pointed out in chapter two, I am dealing with what I see as one development over the past three centuries, one series of branching streams in a delta - this series runs beside and does not exclude other developments. Secondly, I am interested in how we currently make sense of the history

¹⁶Young 5.

of literature and science and their interactions, and so am inevitably dealing with the schematic stories which we tell in order to make sense of where we are today. My interest is therefore, not so much in a 'correct' history, as in a particular version of that history which has come to have an influence upon contemporary literature and science writing.

Inevitably, once notions of the object of study (literature) have been questioned by poststructuralists, both the subject who perceives the object, and the discourse which the subject uses to articulate it, must also come under interrogation. By suggesting that the structures which are found beneath the surface of the text by the structuralists are not pre-existent, they suggest that the reader brings meaning to the text as it is read. Barthes's famous 'Death of the Author' essay, written early in his poststructuralist phase, illustrates this perfectly: 'a text's unity lies not in its origin but in its destination.'¹⁷ The author is no longer the originator of a single meaning; meaning is assumed to lie instead with the reader and the reader's interpretation of the text (and the way in which that interpretation is dependent upon the range of other texts that the reader has read). Because the reader brings meaning to the text, we can no longer think of reader and text, subject and object, as separate entities.

Selden and Widdowson describe this process in their chapter on poststructuralism in *A Reader's Guide to Literary Theory*, in which they argue that poststructuralism involves a critique of empiricism, the dominant philosophical mode since the Enlightenment. Their definition of empiricism is worth noting because it takes us back to the definitions of knowledge which I described in chapter one: '[Empiricism] saw the subject as the source of all knowledge: the human mind receives impressions from without which it sifts and organises into a knowledge of the world, which is expressed in the apparently transparent medium of language. The "subject" grasps the "object" and puts it into words.'¹⁸ Although Descartes is associated with rationalism rather than empiricism, what we have here is a split between subject and object that stems from the same source as Descartes' split between body and mind. Furthermore, the assumption that language is a transparent medium for the transmission of knowledge is equivalent to that which I associated with the Enlightenment in chapter one.

They argue that poststructuralists now postulate a theory of 'discursive formations' as a more viable alternative which renders the subject/object split problematic, and assumes that both are created by discourses: 'This model has been challenged by a theory of "discursive formations", which refuses to separate subject and object into separate domains. Knowledges are always formed from discourses which

¹⁷Roland Barthes, 'The Death of the Author,' *Image, Music, Text*, ed. and trans. Stephen Heath, Fontana Communications Ser. (Glasgow: Fontana, 1977) 148.

¹⁸Selden and Widdowson 128.

pre-exist the subject's experiences. Even the subject itself is not an autonomous or unified identity, but is always "in process". . . .¹⁹ What they are identifying then, is a view of the 'knowing' subject which is very similar to that identified in the quotation from Lyotard in the introduction - not as an independent, objective entity, but as part of the 'communication circuits' and systems which he or she studies.

This notion can also be found buried in other poststructuralist texts - the notion of intertextuality implicit in Barthes's *S/Z* for instance. Rather than assuming, as did the structuralists, that there was one structure to find which would underpin a text, Barthes suggests, as Selden and Widdowson put it, that '[e]ach text refers back differently to the infinite sea of the "already written".'²⁰ This sea will be different for each of us, dependent on the texts - literary and otherwise - that have shaped us, and the communication circuits of which we are a part. So the subject is not assumed to be the autonomous entity that Enlightenment discourses propose.

The notion of discourse itself also undergoes a radical transformation in this phase of the literary strand of the discourse. This transformation is a development from the notion of language proposed by Saussure. Selden and Widdowson again provide a good account of this transformation. As they point out, Saussure had said that there is no necessary connection between signifier and signified and, famously, that 'in language there are only differences *without positive terms*.'²¹ However, while this was acknowledged, it was assumed that in practice signifiers became attached to particular signifieds by the common agreement of a community of speakers: 'while the signifier/signified relationship is arbitrary, speakers in practice require particular signifiers to be securely attached to particular concepts, and therefore they assumed that signifier and signified form a unified whole and preserve a certain identity of meaning.'²²

In contrast, they say, poststructuralist thought 'has discovered the essentially *unstable* nature of signification'²³ by prising apart the two halves - signifier and signified - of the sign. Rather than being a single unit with two sides, the sign is a 'momentary "fix" between two moving layers'²⁴ for poststructuralists. This is

¹⁹Selden and Widdowson 128-29.

²⁰Selden and Widdowson 134.

²¹Selden and Widdowson 14.

²²Selden and Widdowson 126.

²³Selden and Widdowson 126.

²⁴Selden and Widdowson 126.

important because it leads to one of the key poststructuralist notions - that meaning always runs away from any attempt to pin it down.

We can see this in a number of poststructuralist theories. For instance, Jacques Lacan's re-reading of Freud suggests, according to Robert Young's interpretation, that the subject is a thing which always shifts away and beyond definitions of it: 'The subject's relegation to ex-centricity in Saussure has allowed the re-reading of the Freudian description of the division of the subject as *a construction in language*, with the subject "always a fading thing that runs under the chain of signifiers".'²⁵ In this formulation, the subject is not a unified presence, but an absence, the product of discourse. Because signifiers always fail to make signifieds present, because any attempt to pin down the subject will require the summoning of more and more signifiers without ever reaching one which can bring the subject into existence, meaning (the subject) always slips away.

Derrida's notion of 'différance' is similar: 'Representation never re-presents, but always defers the presence of the signified. The sign, therefore, always differs and defers, a curious double movement that Derrida calls "différance".'²⁶ In both these poststructuralist theories, therefore, we have a sense in which signifiers sit on a constantly shifting plane with signifieds, also constantly shifting, moving on a different plane beneath them. Meaning only comes in momentary, ephemeral 'fixes' between these two layers. Hence meaning is perceived to be constantly slipping away down a chain of signifiers, and out of our reach.

I will take issue with this in greater detail in the introduction to Section Two, but one criticism of it can be briefly sketched here. In the theories outlined above, meaning is presented as a single point, a dot which always slips beyond our grasp, sliding away down a line of signifiers. This gives poststructuralists a way of accounting for the ways in which words constantly shift in meaning, and discourses change and develop. However, in the theory outlined above, communication should be impossible: meaning can never be grasped and different discourses will send meaning sliding away down different chains of signifiers. In the face of this, we need to be able to account for the communication of meaning that does take place.

Obviously, meaning is unstable as this theory suggests - poststructuralist work has shown that the notions of rigidly fixed meaning presupposed by Enlightenment discourses are untenable. However, a more useful image of meaning than the single, self-contained point constantly sliding away from us, might be that of an elastic point, that does not so much slide away from us as stretch and expand across groups of

²⁵Young 13. The quotation from Lacan comes from 'Of Saussure as an Inmixing of an Otherness Prerequisite to an Subject Whatever.'

²⁶Young 15.

signifiers. This would suggest that meaning is problematic and unstable, but also that communication does take place. I will return to this in the introduction to Section Two.

Having seen how poststructuralism launches a critique of Enlightenment assumptions about subject, object and discourse, we are now in a position to see what cultural relationship between science and literature it assumes. In chapter three I pointed out that structuralism gave us a way of seeing science and literature as broadly equivalent by suggesting that they are both semiotic systems. This made a more complex model of the culture than the 'two cultures' one possible. Poststructuralism develops this idea of science and literature as discourses by arguing that everything is discourse. There can, therefore, be no way of grounding any one discourse as more true than any other (this argument is similar to Lyotard's exposure of science as dependent on narrative knowledge, discussed in the introduction to this section). Science and literature are therefore seen as competing discourses, distinguished only by the rhetorical strategies they employ.

The function of literary criticism is also rendered problematic. It can no longer assume the status of a metalanguage (as structuralists assumed) because it can itself be analysed as a discourse, and so we are left with the prospect of a series of infinite regressions from the original text. The only sort of grounding in truth which criticism can claim - and then only provisionally - is in its deconstruction of literary and scientific discourses, exposing their radically unstable natures.

This is a view which I take issue with throughout this thesis because I aim to demonstrate that, while it might be impossible to find divine harmony or stable meaning in literature and science writing, it is justifiable to shun pure deconstruction in favour of adequate approximations of what actually takes place in the relationship between literature and science. This will become apparent in the second section, where I draw out direct links between literature and science. What can be said with certainty now, is that the third phase of the core literature/science discourse involves a renunciation of Enlightenment epistemologies. This takes its most extreme form in poststructuralism, which destroys the notion of a unified subject who can fully know a separate, pre-existent object: 'In brief, it may be said that poststructuralism fractures the serene unity of the stable sign and the unified subject.'²⁷

In the three phases of the core literature/science discourse, we have moved from a view of knowledge and legitimation homologous with that supposed by Descartes, to one more equivalent to the postmodern epistemologies proposed by Lyotard. I will formulate my own theoretical position, in respect of this history of literature and science, in the next chapter and in the introduction to section two.

²⁷Young 8.

CHAPTER 4

JUSTIFYING THE LITERATURE/SCIENCE DISCOURSE: CANONS OF THE POST-ENLIGHTENMENT

In this chapter I will justify the history of literature, science, and literary theory which I outlined in chapters one to three. This will entail an exploration of the limits of its applicability, by dealing with possible objections to it, and will suggest that it is a history which naturally emerges from the processes of canon formation that are at work in our society.

The Core Literature/Science Discourse: Clarifying Statements

In the preceding chapters I suggested that there were parallel developments in the histories of literature, science and literary theory. These separate disciplines are connected, I argued, by the changing assumptions they make about what constitutes legitimate and illegitimate knowledge. The main thrust of these developing notions about what is accepted as true is a transition from 'Enlightenment' to 'postmodern' discourses of knowledge.

Having proposed a history and a model of knowledge which challenge the two-cultures dogma, it is now necessary to highlight the assumptions buried within these new proposals about literature and science, and deal with possible objections to them. So far, I have merely pointed out the similarities between different disciplines. This runs the risk of producing an argument based on a facile analogy, similar to that derided by Gould in the quotation I used to introduce the thesis: there are similarities between two things; therefore they are linked.

Analogy can only be useful to the extent that it suggests a potential homology: there are similarities between two things; therefore they *might* be linked. Having drawn out the similarities between various disciplines, I will use this chapter to justify my contention that there is a homologous relationship between them. What exactly do we mean when we say that literature, science and literary theory have developed in a contiguous fashion? Why are there these similarities between them?

There are two main potential objections to the history I have postulated, one general and one specific, and dealing with these objections will enable me to answer the questions I have posed. The general objection is this: why just literature and science? If we can demolish the walls between these disciplines, do we not also need to demolish other boundaries and forge connections between the other arts, and indeed between all areas of the culture, in order fully to comprehend literature and science? If we need the scientific context fully to appreciate literature, and vice versa,

do we not also need the historical, the economic, the political and the social contexts too? Does this not imply that focusing almost exclusively upon literature and science may have produced an overly schematic and simplistic history?

There is justification in these objections, to the extent that links between literature and science do indeed imply that there must also be connections from literature and science to other cultural contexts like history and politics. It is wrong, though, to suggest that an account of one aspect of the culture must also include every other cultural dimension. A somewhat schematic representation - a simplification of deep complexity - is necessary in order to make sense of the culture.

I focus almost exclusively upon literature and science in order to show how our view of culture itself has evolved. For a long time, and with growing efficacy throughout the Enlightenment, the two-cultures assumption set up literature and science in direct opposition to one another. Literature was an acknowledged part of culture, but science, viewed popularly in terms of a dimension of absolute truth, stood outside of anything we would normally term cultural. Although Snow and others described science as a 'culture,' its real status was as an antithesis to everything that we now think of as cultural. Objective, true and rationally verifiable, it was then an *anti-culture*.

This 'anti' meant both 'opposite to' and (with increasing force for people like Arnold, Richards and Leavis) 'a threat to.' While science stood outside of culture, literature was frequently promoted as a champion for the cause of culture and of the Arts. This explains why Snow and Leavis argued about Science and Literature, rather than Science and the Arts.

By tracing the erosion of this two-cultures viewpoint, I am charting, broadly and schematically, the rise of a view of culture as a nest of changing, competing discourses, of which some of the most influential are scientific. My focus is on the integration of science into a new concept of culture. Although it is reasonable to suppose that the same attitudes toward knowledge that I have identified can also be found in other sorts of discourse, a concentration upon literature and science is justified in order to exemplify this process.

The two-cultures tradition placed literature and science at opposite poles of knowledge: literature was a symbolic champion for the cause of culture, and science stood in opposition to it. To demonstrate that these polar opposites are in fact entwined (how even their construction as 'polar opposites' resulted from a historically-specific process), is to demonstrate how the concept of culture has changed. Extensive reference out to other cultural spheres is unnecessary, although some limited movement beyond the bounds of literature and science is inevitable.

This deals with the general objection to my project, but there is a specific challenge to my argument which must also be considered: why have I focused on a

particular three-phase history of literature, science and literary theory, rather than any other version of that history? Are there not other, equally legitimate, histories which do not describe a movement from Enlightenment, through crisis, to postmodernism? For instance, is there not a scientific tradition which builds upon past knowledge in a fairly steady way, without questioning our assumptions about what counts as true? Does not the realist literary form persist quite strongly into the present? - indeed, are not most novels which are published today realist? Furthermore, is there not a branch of literary criticism which continues to describe literature in a fairly conventional way? Why have I ignored these histories?

The response to these specific objections must, as with the general objection, include partial agreement with them. Other histories of literature, science and literary theory do exist. This can be demonstrated by reference to one example in which the sort of history I have described coexists with a very different sort of history in the same text.

Tim O'Brien is a writer whose novels have a definite postmodern (in other words, third-phase) form, and yet in *The Nuclear Age* there is a scientific discourse which places great emphasis upon science as an absolute truth, and even explicitly refutes arguments that science is a transient description like any other. In other words, science operates within the text as a universal, a-cultural force that is not subject to the sorts of transitions which I have described.

It enters the text because the narrator, William Cowling, uses it to give expression to his fears of nuclear war. He is beset by views of reality as provisional, or accessible only through metaphors which translate pure truth into something else, and he invokes science to make clear that the reality of the phrase 'nuclear war' is what is important, not any semiotic subtleties: 'There are no metaphors. There is only science when I say, "Nuclear war."' ¹ Science is strongly associated with truth, and it is used here to suggest that the truth contained in the words is much more important than pedantic quibbles about all language being metaphorical.

It is even suggested that a preoccupation with metaphors, and other evasions of reality, is characteristic of our era: 'The world, I realize, is drugged on metaphor, the opiate of our age. Nobody's scared. Nobody's digging. They dress up reality in rhymes and paint on the cosmetics and call it by fancy names. Why aren't they out here digging [a nuclear shelter]? Nuclear war. It's no symbol.' ² Although we later discover that Cowling's fears, which result in an obsessive desire to build a nuclear shelter, also stem from anxiety that his wife is going to leave him, this does not alter

¹Tim O'Brien, *The Nuclear Age* (1986; London: Flamingo-Fontana, 1987) 126.

²O'Brien, *Nuclear Age* 124.

the basic thrust of the novel. It maintains that scientific descriptions of reality cannot be dismissed as metaphors - as his wife, significantly a poet, seems to think they can. Even Cowling's eventual decision to subscribe to his wife's way of thinking, and suppress his fears of nuclear holocaust, is presented in the last lines of the book as knowing self-deception in the face of overwhelming evidence:

I will live my life in the conviction that when it finally happens - when we hear that midnight whine, when Kansas burns, when what is done is undone, when fail-safe fails, when deterrence no longer deters, when the jig is at last up - yes, even then I will hold to a steadfast orthodoxy, confident to the end that *E* will somehow not quite equal mc^2 , that it's a cunning metaphor, that the terminal equation will somehow not quite balance.³

Science, in this presentation of it, is associated with truth. It does not have any of the characteristics of a third-phase discourse, even though some of the novel's other characters perceive it in that way.

This is interesting because so many of O'Brien's novels have many forthright postmodern characteristics, particularly in relation to the question of knowledge, which is usually presented as highly problematic. In *Going after Cacciato* an American soldier in Vietnam struggles to distinguish between a mission to capture an AWOL colleague, and his own fantasies about walking right away from the war; in *The Things They Carried* there is a persistent tension between fictional elements of the short stories, and O'Brien's own experiences in Vietnam; and *In the Lake of the Woods* refuses to choose between the possible theories which might account for the mysterious disappearance of Kathy Wade. These concerns with the status of knowledge, and these attempts to problematise it, are also present in *The Nuclear Age* - yet, science assumes the position of absolute, and unquestionable, truth in the novel. So even though O'Brien's work participates in third-phase discourses, *The Nuclear Age* draws upon a scientific discourse which is characteristically first-phase.

This illustrates how first-phase discourses persist into the present - often alongside, and in competition with, third-phase discourses. As a result it is necessary to slightly modify our understanding of the core literature/science discourse. Movement from one phase to another does not take place in an absolute fashion, with each strand of the discourse switching automatically from one phase to the next, and completely abandoning the previous mode of knowledge. Two characteristics serve to complicate the evolution of the discourse.

The first is the principle of accumulation, whereby modes of knowledge do not supplant or replace one another but build up and accumulate. The result is that a

³O'Brien, *Nuclear Age* 312.

number of competing discourses, in different phases of development, can co-exist, as we found in O'Brien's work. The second is the principle of exclusivity, whereby modes of knowledge evolve along separate, exclusive lines of development, apart from the movement from modern to postmodern. We can see this in the persistence of realist novels, as a viable literary form, into the present - realism is not truncated by the appearance of modernism and postmodernism; instead, these mark branching points where one group of texts evolve along modernist lines, and another group continue to evolve along realist lines. In this understanding modernity and postmodernity are not so much mutually exclusive cultural epistemes, as different emphases in separate discourses of knowledge. Just as different species of animals may have evolved from a common ancestor, without either being wiped out by competition from the other, so postmodern discourses might be seen as new species of narrative which are becoming more prevalent, and only gradually supplanting the narratives associated with modernity.

The aim of the first section of the thesis, therefore, has not been to describe the only history of literature and science that is available to us. I have not tried to find the one, true history, because no such thing exists, but instead have attempted to trace one of a number of possible histories. Reference back to the image of the river delta as a fit metaphor for history, which I proposed in chapter one (page forty-nine), will illustrate what I mean. There is a maze of channels which branch and diverge, and indeed also converge, with each other again and again. Each route through these channels represents a different, correct version of history. I have traced just one sequence of paths through these channels, a route which represents the move from modernity to postmodernity in literature, science and literary criticism.

I am therefore assuming that history cannot be described by just one account, one metanarrative that serves to explain all others, but that different phenomena have to be accounted for in different ways. We cannot viably propose that there is a single history, because all histories involve processes of editing and selection which transform the reality they attempt to describe. We must rather emphasise that there are multiple histories. This is not, however, a position of complete relativism. Just because there is no one 'right' history, because there is no Truth in the sense of a single narrative that will render the world, does not mean that there are not 'wrong' histories. Each history must be legitimated by the adequacy with which it accounts for the development of the phenomena it is attempting to explain. Each history is therefore constrained by the fact that it can be falsified by another history which explains the same phenomena, the same set of evidence, more fully - in other words, with less contradiction - or by introducing new evidence which transforms the old history.

This is the sort of legitimisation for which I must aim with my three-phase discourse. How adequately does it account for the succession of texts that chart a progress from the Enlightenment to the postmodern? I can justify my version of this history as more adequate than any other, by reference to the ways in which the processes of canon-formation have, in each strand of the discourse, led to a dominant version of history in contemporary culture, emphasising the progress through the three phases I have identified.

It could be objected that this does not really legitimate the history I have proposed because I will be justifying it by reference, not to the reality of historical development itself, but to current versions of that history. This is, however, deliberate. My object of study is contemporary, postmodern literature and science writing. Therefore, in order to see how these contemporary discourses are shaped by history, we need to look, not at all the texts which constitute history, but rather at those texts which contemporary discourses invoke in order to explain their current status. Contemporary texts invoke a selection of prior texts in order to produce a coherent history which leads to the present time. This process of canon formation produces the history I outlined in chapters one to three. Because this is the version of history which postmodern exponents of literature, science and literary theory are aware of, in one form or another (they do not have to label it as postmodern), this is the one which affects the work they produce and the significance they attach to themselves and their work.

All that remains for me to do in this section of the thesis, then, is to justify the history I have produced by showing how it is implicit in the canon invoked by postmodern literature, science and literary theory. I will go through each of these strands of the core discourse in turn.

The Canon of Literature

The terms *postmodern*, *postmodernism* and *postmodernist* obviously imply something which comes after modernism. Because they are regularly applied to literature - it is a commonplace to talk about postmodern literature - it is perfectly reasonable to assume that there is a contemporary version of literary history identifying, either explicitly or implicitly, a transition from modernism to postmodernism. The existence of critical works like Brian McHale's *Postmodernist Fiction*, bears this point out. It is therefore fair to say that the very existence of a body of literature which is labelled postmodern, implies a contemporary discourse concurring with my suggestion in chapter three that there is a shift from modern (second phase) to postmodern (third-phase).

This rather obvious point is worth making because, while the argument that postmodernist literature succeeds modernist literature is rather self-evident, this is less obviously so with regard to science. There are no wide-ranging, fairly well-accepted terms like 'postmodern' current amongst scientists that make it easy to pinpoint a widely perceived transition. I shall of course return to this point in the section below about canon formation in science.

So we can take it that there is a shift from modern to postmodern in literature, but are its main features the same as those I outlined in chapter three? Is the key element a move from interrogating how we perceive reality, to disputing the whole notion of reality? McHale's contention in his book, that postmodernist can be distinguished from modernist fiction because it raises ontological, rather than epistemological, questions, bears this out, and suggests that there is a contemporary discourse implying a canon of literature similar to that supposed by my arguments in chapter three.⁴

This definition of modernism can also be drawn from attempts to sum it up for general readers. *The Oxford Companion to English Literature* offers T.S. Eliot, Ezra Pound, James Joyce, Virginia Woolf, W.B. Yeats, Ford Madox Ford and Joseph Conrad as examples of writers with whom modernism is 'particularly associated'⁵ - in other words, it tentatively offers these writers' works as a canon of modernist literature. It then goes on to say that a 'sense of cultural relativism is pervasive in much modernist writing' and that it is also marked by 'an awareness of the irrational and the workings of the unconscious mind.' Because these statements home in on relativism and the mind itself, they imply a focus upon multiple perceptions of reality that accords with the viewpoint I outlined in chapter two: modernism as a questioning of how we perceive the world. Indeed, some of the techniques employed by the writers cited in the entry would seem to emphasise this aspect of modernist literature - one thinks particularly of the streams of consciousness used by Woolf and Joyce, which focus the reader exclusively upon how a character perceives the world, instead of the world itself.

So this accords with my second phase of the discourse. *The Oxford Companion* goes further though, because it also defines modernism backwards, by virtue of its difference from previous literary forms and, in my terminology, first-phase literature or realism. Modernism 'rejected the traditional . . . framework of narrative, description, and rational exposition' and is 'based upon a sharp rejection of the procedures and values of the immediate past.' In this reading it is therefore a

⁴McHale 9-10.

⁵'Modernism,' *The Oxford Companion to English Literature*, 1991 ed.

significant shift in literary history which harmonises with that outlined in chapter two of this thesis. If it rejected 'traditional' narrative forms, stressing relativism and a focus upon the mind, then these traditional forms could not themselves have carried these features. In other words there is an implication buried within this entry that there was a literary tradition, preceding modernism, which rejected any form of relativism and which focused on an external, rather than a psychological, world.

If we turn to the entry on realism in the *Oxford Companion*, we find this point reiterated. It acknowledges the difficulty of defining realism and does not use the term in quite the all-inclusive way that I have used it, but nevertheless offers a series of definitions which are consistent with my use of the term in chapter one. For instance, Sir Paul Harvey, the compiler of the first *Oxford Companion to English Literature*, is quoted thus: 'truth to the observed facts of life.'⁶ This assumes, of course, that the 'facts of life' are the same for all observers - that reality is commonsensical and accessible. A similar point is made by reference to the French realist school of the nineteenth century which, we are told, 'insisted on accurate documentation, sociological insight, [and] an accumulation of the details of material fact. . . .' Interestingly, the entry on literary realism is preceded by one on realism in Scholastic philosophy which defines it as 'the doctrine that attributes objective or absolute existence to universals.'

So *The Oxford Companion* defines modernism backwards, albeit in a rather guarded fashion, by virtue of its difference from realism. Realism, despite the difficulties of definition acknowledged by the *Companion*, is associated with a more universal, easily accessible version of reality. Modernism complicates this view by dwelling upon various sorts of relativism (whereby differing views of reality are acknowledged), and by focusing upon a particular sort of psychological world (because it emphasises a fragmentary series of different views of the world).

Interestingly, the *Oxford Companion* does not have an entry on postmodernism. However, if we were to pursue the implications of the observations I have just made - that modernism complicates a commonsensical reality - than it would be logical to assume that postmodernism (that which comes after and goes beyond modernism) would exacerbate this process.

This is not, of course, the only way of interpreting the move from realism, through modernism, to postmodernism. However it is one version of that literary history which has attracted attention and has had sufficient influence for a canon of exemplary texts to be formed around it. This canon reinforces that version of literary history, and it is the way in which postmodernist literary texts fit into the final phase

⁶'Realism,' *The Oxford Companion to English Literature*, 1991 ed.

of this canon, and perpetuate the history it assumes, which I will be exploring in the second half of my thesis.

A similar canon can be found in literary theory, the three phases being represented by a movement from 'traditional' literary criticism, through formalism and structuralism, to poststructuralism. In order to demonstrate this I shall look at the texts that are invoked by various 'readers' in literary theory which, because they are often published with students in mind, are key in the formulation of widely accepted canons of literary criticism.

The Canon of Literary Theory

As with the literary canon there is a useful prefix to one of the key terms in the canon of literary theory - 'post' structuralism implies a development from and beyond structuralism. This gives us the second and third phases of the discourse: structuralism and poststructuralism.

We can find these, for instance, in Philip Rice and Patricia Waugh's anthology of literary criticism, *Modern Literary Theory: A Reader*, which is divided into two parts, the division between them corresponding broadly to that between structuralist and poststructuralist approaches to literature. The first part has six sections - 'Saussure,' 'Russian Formalism,' 'Structuralism,' 'Marxism,' 'Reader Theory' and 'Feminism' - which encompass a range of essays that function, to a greater or lesser degree, within the confines of the second phase of literary theory, outlined in chapter two. Rice and Waugh's introduction to this part of their anthology is extremely interesting.

Although their anthology omits essays which belong to the first phase of the discourse I have postulated, they do admit that a body of literary criticism exists, preceding the work that they include for the modern student of literature. Contemporary literary theory is defined, they suggest, by its attack on 'the grounding assumptions of the Anglo-American critical tradition.'⁷ This critical tradition is, in my terms, the first-phase discourse. This is confirmed by Rice and Waugh's one-sentence summary of the tradition which modern literary theory rejects: 'the notion that something called "literature" existed was never in doubt; nor was the sense that the author was the originator of the work, or that the act of criticism was subordinate to the literature it studied.'⁸ What this emphasises, above all, is the commonsensical nature of traditional literary criticism, and the sense in which the object of study is

⁷ Philip Rice and Patricia Waugh, *Modern Literary Theory: A Reader*, 2nd ed. (1989; New York: Routledge, 1992) 1.

⁸ Rice and Waugh 1.

assumed to be 'out there,' accessible to everyone who approaches it in an objective fashion. Literature exists independently of the observer, and can be studied as a discrete object.

This brief summary of early literary history therefore suggests that its view of reality (of a literary reality) is similar to that which I proposed as characteristic of first-phase discourses: it exists in an objective fashion, separate from the observer. Although there are no examples of this sort of tradition included in the anthology - it is after all a reader in 'modern' literary theory - it implicitly postulates a canon of criticism which would include the work of critics like Richards, whom I discussed in chapter one.

Interestingly, in elaborating on the presumptions made by this sort of criticism, Rice and Waugh imply that it fits naturally with realist literature - the first phase of the literary strand of the discourse. They say that, despite the variety of early, traditional critical approaches, they 'all accept a broadly mimetic view of literature where literature in some way or other, reflects and delivers up "truths" about life and the human condition. . . .'⁹ This suggests a literature which strives to mimic or mirror reality in much the same way as I have described realism doing. Perhaps more experimental forms of literature, like modernism and postmodernism, by calling into question the relationship between text and world, serve to make critics think more about their own critical practice, and the relationship between their texts and the literary worlds they describe. This does imply a relationship between two similar, first-phase views of reality - in literature and literary theory - which goes beyond analogy and reaches the status of homology.

As I have argued, the first part of Rice and Waugh's anthology is comprised of essays which broadly encapsulate the second phase of the core literature/science discourse. It is interesting that the only section of their book which is devoted to a single, named critic is that which begins the anthology, and is reserved for Saussure, the key linguist for structuralist (and indeed poststructuralist) approaches to literature. The attack on traditional critical practices derives, Rice and Waugh argue, largely from Saussure's linguistic theory. Summarising his viewpoint, they say that he moves away from a view of language as a 'mere tool devised for the re-presentation of a pre-existent reality' to one in which it is a 'constitutive part of reality, deeply implicated in the way the world is constructed as meaningful.'¹⁰ In other words the shift is away from a separation between language (and, of course, the user of language) and world, to a closer integration of the two. This implies a collapsing of

⁹Rice and Waugh 2.

¹⁰Rice and Waugh 3.

the distance between observer and observed similar to that I described in chapter two, and a refocus upon the way in which literary reality is perceived, rather than on literary reality itself.

So in their introduction to the first part of their anthology, Rice and Waugh imply a distinction between pre-structuralist and structuralist literary criticism which mirrors the split between the first and second phases of literary history that I identified. This is of course a schematic distinction, as I have already argued, and as Rice and Waugh themselves acknowledge, both in their introduction and by their inclusion of sections on feminism and reader theory, which do not fit neatly into the structuralist camp.

The move to a third-phase discourse - and to the second part of Rice and Waugh's anthology - is also problematic. They argue that, although they have made a distinction between parts one and two of their book, 'this division is not meant to imply an historical progression from, for instance, the inadequacies of structuralism to a more satisfactory post-structuralism.'¹¹ Nevertheless, they do seem to imply a difference of degree between what I have labelled the second and third phases of the discourse, for 'while it [the material in the first part of the anthology] is less radical it does prepare the ground for the work represented in Part Two which generally adopts a more interrogative and disrupting perspective.'¹² So, while the move from structuralism to poststructuralism may not be 'a matter of simple causal development',¹³ as Rice and Waugh argue, the fact that they split their anthology into two parts does suggest that they perceive a difference between the two types of modern literary theory which supersede the traditional approaches. Moreover, although it may be impossible to talk of poststructuralism as a simple progression from structuralism, it is hard to conceive of their anthology working so well as a guide to literary theory if the 'poststructuralist' section came first. However inadequate a simple binary divide between structuralist and poststructuralist approaches may be, and however hard Rice and Waugh may try to undercut the division of their book into two sections, there is little doubt that they find this arbitrary division to be a useful way of schematising recent literary theory.

Their selection and packaging of critical texts therefore represents a process of canon-formation which underwrites the history I offered in the first section of this thesis. In order to make sense of the present state of literary theory Rice and Waugh have selected a canon of texts, and written an introduction to them, which emphasises

¹¹Rice and Waugh 4.

¹²Rice and Waugh 4.

¹³Rice and Waugh 4.

movement from a traditional, commonsensical literary criticism (first-phase discourse); through a relatively moderate questioning of its assumptions (second-phase discourse); to a more radical questioning of both the object of literary study, and of literary theory itself (third-phase discourse).

Of course, this version of the evolution of literary theory is not accepted universally, and other collections of literary critical essays do not always split neatly into parts which mirror my presentation of it. For example, Rick Rylance divides his *Debating Texts: A Reader in Twentieth-Century Literary Theory and Method* into seven sections, and makes no explicit attempt to schematise the history represented by this collection of essays any further. However, it is certainly reasonable to suggest that the scheme I have outlined is one way in which the history of literary theory has been presented and understood. Indeed, once we have the notion of a broad three-phase development in our minds, it becomes very easy to find this pattern, even in anthologies like Rylance's which do not explicitly mention a three-phase development: his first section, 'The Force of Tradition,' deals with first-phase texts; sections two and three, 'Versions of Formalism' and 'The Analysis of Structure and Meaning,' seem to be concerned with second-phase discourses, and section four, 'Developments after Structuralism,' suggests a progression onto a third-phase discourse.

As with Rice and Waugh's anthology there are sections which do not fit into this broad framework so comfortably. For instance, the sections 'Literature and Society: Marxist Approaches' and 'Feminism and Literature,' in Rylance's book mirror sections on the same issues in Rice and Waugh's collection. Neither of these topics fits, of itself, into the overall pattern of historical development I have outlined.

This discrepancy takes us to the heart of the argument I am making: the history I have sketched, in literature and science, as well as in literary theory, is not a metanarrative which accounts for all aspects of contemporary culture. However, it does account convincingly for those ways in which we see ourselves as different to our seventeenth-century counterparts, explaining our present condition by drawing out the ways in which our culture is different to that of our Enlightenment predecessors. It is the framework we use to explain whichever aspects of our culture we now see to be characterised by a condition of postmodernity, rather than one of modernity.

Hence those texts in both Rylance's and Rice and Waugh's collections which deal, when taken together, with a progression in literary criticism, fit broadly into the framework I have outlined (this is not to say of course that it is not possible to find other frameworks which deal with a different sort of progression - the point is that the framework I have described is widely enough accepted to exert an influence on how we see our culture). Issues like Marxism and Feminism can be understood as separate

issues, important enough to be approached in isolation from other literary theory; they are of such importance that we may wish to think about the issues they raise outside of the context of the overall development of literary theory.

Of course, if we focus on these Marxist and Feminist issues in enough detail, we may well find a subsidiary canon which isolates a development within them which also displays the characteristics of the three-phase transition. For instance, the development of Marxist literary theory could be seen as an evolution from a crude base/superstructure model, where base and superstructure exist in an objective sense, with literature blandly reflecting the simplistic causal fashion in which base influences superstructure; through the work of someone like Antonio Gramsci, where culture becomes a battleground used to influence historical development (and so where the reality of base and superstructure is problematised by different cultural perceptions of them); to the work of critics like Louis Althusser and Pierre Macherey, which fit in with a more poststructuralist perspective on the issues about texts, world and society raised by Marxism. Similarly, the progression within Feminist literary theory could be broadly characterised by a development from an initial project, to rediscover and promote forgotten or suppressed women writers; through an attempt to read male writers against the grain, in order to bring out different perspectives on the literary worlds they present us with; to a more complex understanding of the construction of masculine and feminine identities, and their relationship with the culture.

Either of these histories - of Marxist or Feminist literary theory - would in some senses be inadequate, just as my broad histories of literature, science and literary theory are, in some senses, inadequate: they ignore the persistence of earlier critical practices into the present; and they assume an internal 'law' of deterministic historical development, which obviously does not exist. However there is value in both their utility (they are stories which help us to understand the multiplicity of changing critical practice by schematising it) and in their prevalence (they are influential enough for an analysis of them to be essential for an understanding of our culture).

Scientific texts pose more problems because a different sort of history - one of a perpetual accumulation of facts and laws - is more popularly accepted as being true of science. Nevertheless, there is a definite sense in which a canon of scientific texts has been formed around the sort of progression I outlined in chapters one to three. Because this fits into the pattern of literary and literary-historical development from modernity to postmodernity, an understanding of postmodern culture would be incomplete without it.

The Scientific Canon

A key complicating factor in this thesis has been the impossibility of dealing directly with scientific texts in order to understand science. While it has been feasible to go straight to the appropriate literary and literary-critical texts, in order to unearth the history of their development during the last three centuries, the technical complexity of the corresponding scientific texts has blocked off this route to an understanding of science.

However, this has not proved to be a handicap because I have limited my interest to the cultural value of science, rather than science itself. The focus has been, and will be in the case studies which constitute section two of this thesis, on those texts which present science to a wider audience, shaping the public perception of it, and therefore impacting upon the culture. Of course, many of these texts are directly influenced by science, and some are written by scientists themselves.

This sense in which science is seen as an important cultural player has arisen as a challenge to the ill-named 'two cultures' debate, in which science was taken to be the antithesis of culture. The canon which coalesces to describe the changing status of science is composed of popular versions of scientific ideas, appearing in passing references in literary or journalistic texts, and in books dedicated to the popularisation of scientific ideas. I concentrate upon the latter because they provide the more easily identifiable body of scientific conceptions.

Popular science, the term which is often applied to these, is disliked by some because it implies 'run of the mill' and 'not worthy of serious analysis.' An alternative term, *reflective science writing*, was proposed by a panel of contributors to the 1995 meeting of the Society for Literature and Science in Los Angeles. The session abstract emphasised their desire to raise the profile of this sort of writing: "Reflective" science writing is writing by scientists who address nonspecialists in prose styles that reveal recognizable "literary" qualities, differing in this way from the writing of scientists for other scientists. Such writing can cross disciplinary boundaries and form a bridge between the "two cultures."¹⁴

Such a qualification may seem superfluous, and even rather churlish, in the current critical climate, which has so successfully undercut the mystical distinction between 'literary' and 'popular' literature. However, it does emphasise that books about science are worthy of serious literary analysis, and it is this sense which I wish to maintain, even though I choose to use the phrase *science writing* in the interests of brevity.

¹⁴Sidney Perkowitz, et al., 'The Art of Reflective Science Writing' (unpublished programme for the 1995 conference of the Society for Literature and Science).

The relatively new interest in the literary qualities of science writing comes from both sides of the supposed two-cultures divide. Evidence that there is an interest within the Sciences in this issue, can be found in the fact that the panel for the Literature and Science conference, referred to above, included Sidney Perkowitz, from the Department of Physics at Emory University, Atlanta; Peter Brown, editor of *The Sciences*; and K.C. Cole, science writer for the *Los Angeles Times*.

The publication of *The Faber Book of Science*, edited by John Carey, the Merton Professor of English Literature at Oxford University, shows that there is a corresponding interest within literary studies. His anthology demonstrates the literary esteem in which attempts to explain the complexities of modern science are held, and his introduction makes this point emphatically, arguing that some scientists 'have created a new kind of late twentieth-century literature, which demands to be recognised as a separate genre, distinct from the old literary forms, and conveying pleasures and triumphs quite distinct from theirs.'¹⁵

Is there any evidence that this sort of science writing has been arranged into a canon, or invokes a canon, to reflect the programme of development that I described in chapters one, two and three though? Certainly Carey's volume constitutes a canon of sorts, offering as it does a selection of texts about science, and presenting them in chronological order so as to give a sense of historical progression, turning the book, as Carey puts it, 'into a story - a way of taking in the development of science over the last five centuries.'¹⁶

However, the primary selection criteria for Carey's volume seems, not so much to have been to describe the development of science, but to bring to the public's attention the excellence of much science writing: 'the first question I asked about any piece I thought of including was, Is this so well written that I want to read it twice?'¹⁷ So, although in reading the volume we do get a sense of scientific development - particularly through the enlightening introductions that Carey gives to each piece, some of which (like the one demonstrating the difference between Newton's and Einstein's views of the universe)¹⁸ concur with my observations about historical development and some of which do not - the anthology reads most obviously as an introduction to excellent science writing, and to some science, rather than as a history of the development of science. The impression that Carey gives in his introduction,

¹⁵John Carey, introduction, *The Faber Book of Science*, ed. Carey (London: Faber, 1995) xiv. It should be noted that Carey also includes some earlier science writing in this new literary genre.

¹⁶Carey xv.

¹⁷Carey xiii.

¹⁸Carey 270.

and in his selection of texts, is that he has not been looking for writing which illustrates certain key ideas, but for writing which is likely to engage the reader.

So where can we find texts which postulate a history of science like the one I have described and, either directly or indirectly, a canon to support that history? Texts which use the term *postmodern* as an adjective to describe science, tend to approach it from a literary perspective, a theological perspective, or from that of the history or philosophy of science, rather than science itself. An example of the first is the work of N. Katherine Hayles, instances of the second come from Frederick Ferré, David Ray Griffin and Stephen Toulmin, and Zuzana Parusnikova provides evidence for the third.¹⁹

However, if we are willing to widen our net to include instances where the term *postmodern* is not actually used, but in which a history of science similar to that I have outlined is implied, then we can find a postmodern history in texts which are more obviously scientific - and probably reach a wider, less specialist audience - than those cited above. The presentation of chaos theory in science writing provides a prime example of this sort of presentation of a history of science. Brief reference to two texts will serve to demonstrate this.

The New Scientist Guide to Chaos reprints a complete series of articles about chaos theory and its implications from the *New Scientist* magazine. In her introduction, the editor, Nina Hall, offers a brief, four-page history of science leading up to the development of chaos theory, which accords almost exactly with the history of science that I have described. After two initial paragraphs, explaining the appeal of chaos theory, she states that scientists have always searched for the underlying laws which control the universe, offering Isaac Newton as a prime exponent of this, and describing how Laplace proposed an entirely deterministic view of the universe, based on Newtonian principles. This therefore equates with the status of early modern science which I highlighted in my analysis of first-phase discourses.

Hall's next paragraph begins by describing a crisis in this viewpoint, precipitated by the challenge to strict determinism from quantum physics: 'This deterministic view received its first blow in the 1920s, when quantum mechanics was developed to describe the world of the very small.'²⁰ Hall makes clear that, although this constituted a crisis in the old world view, it did not serve to undermine it completely because it retained some semblance of the old ideas: 'Nevertheless,

¹⁹Hayles, *Chaos Bound*. David Ray Griffin, ed., *The Reenchantment of Science: Postmodern Proposals* (New York: State U. of New York P., 1988). Stephen Toulmin, *The Return to Cosmology: Postmodern Science and the Theology of Nature* (Berkeley: U of California P., 1982). Zuzana Parusnikova, 'Is A Postmodern Philosophy of Science Possible?', *Studies in History and Philosophy of Science* 23 (1992): 21-37.

²⁰Nina Hall, introduction, *The New Scientist Guide to Chaos*, ed. Hall (London: Penguin, 1992) 7.

physicists have used quantum mechanics to construct a reasonably robust theoretical framework for describing the fundamental properties of matter and the forces at work in the Universe.²¹ Quantum physics is therefore characterised as an attack upon Newtonian assumptions, but one which leaves some of those assumptions intact. In this sense, Hall participates in a discourse which is characteristically second-phase.

Chaos theory is then introduced as, in my terminology, a third-phase discourse, interrogating the assumptions modern science made about what could be known: 'chaos is revealing fundamental limits to human knowledge in an uncomfortable way.'²² Not only does Hall reproduce the three-part pattern (one sort of science, called into crisis, then replaced by another sort of science) that I described, but she also remarks on the ubiquity of chaos theories in different disciplines, thus emphasising that chaos should not be seen as just another sub-discipline of science, but as a key development that takes science in general into new territory. For example, she says that chaos 'can be found in virtually every discipline from astronomy to population dynamics. . . .'²³

The same sort of argument is repeated in Paul Davies's essay, which ends Hall's anthology, and which is partially reprinted in Carey's *Faber Book of Science*. He too cites Newton and Laplace, and situates quantum physics and chaos theory as '[t]wo major developments of the 20th century' which have 'put paid to the idea of a clockwork universe.'²⁴ Again, quantum physics does not quite break with Newtonianism, although it challenges it, because 'there remains a sense in which quantum mechanics is still a deterministic theory.'²⁵ It is chaos theory which, as in Hall's introduction, marks the crucial break - again, therefore, chaos theory is situated in the 'postmodern' moment in the development of science.

One more example will suffice to demonstrate that the history I have produced is widely enough accepted for it to be worthy of study, and for it to interact with other elements of the culture in a meaningful way. James Gleick's highly successful *Chaos* may well be responsible for spreading the doctrine of chaos theory more than any other single book. He too emphasises that chaos is a completely new way of doing science, subtitled his book 'Making a New Science,' and calling one chapter 'Revolution,' describing chaos theory as a wide-ranging revolution of the sort

²¹Hall 8.

²²Hall, 10.

²³Hall, 9.

²⁴Paul Davies, 'Is the Universe a Machine?', *The New Scientist Guide to Chaos*, ed. Hall (London: Penguin) 215.

²⁵Davies 215.

described by Thomas Kuhn. His prologue makes a similar point: 'With the coming of chaos, younger scientists believed they were seeing the beginnings of a course change for all of physics.'²⁶ The emphasis is on a break between old and new ways of doing science. Gleick's chosen method of telling the story, carefully drawing pictures of various scientists as mavericks engaged in outlandish research, and fighting against the grain of conventional science, reiterates the same point: 'A few freethinkers working alone, unable to explain where they are heading, afraid even to tell their colleagues what they are doing - that romantic image lies at the heart of Kuhn's scheme, and it has occurred in real life, time and time again, in the exploration of chaos.'²⁷ The study of chaos is, Gleick implies, something which was so out of the ordinary, so far removed from what constitutes normal science, that it was only those working alone, those who were themselves mavericks, who could initially make headway in this subject.

For instance, take the opening of Gleick's book. The first sentence of the prologue tells us that police in Los Alamos, New Mexico were briefly worried about the strange, nocturnal perambulations of a man in 1974. This, it turns out, was one of the pioneers of chaos theory, Mitchell Feigenbaum, whose hair was 'a ragged mane, sweeping back from his wide brow in the style of busts of German composers' and whose eyes were 'sudden and passionate.'²⁸ Gleick's description of two things about Feigenbaum - his habits and his appearance - immediately serve to locate him as distinctive and maverick. This draws, of course, on a commonplace of American culture - the man, alone, facing the world²⁹ - but also serves to lend the science of chaos these self-same characteristics. In the story that Gleick tells, this new science is also outside the mainstream, waiting to be accepted on its own terms, overturning the status quo.

Like Hall, Gleick also stresses the ubiquity of chaos in order to suggest that it is not just a branch of traditional science, but marks an important break from previous assumptions:

Now that science is looking, chaos seems to be everywhere. . . . No matter what the medium, the behavior obeys the same newly discovered laws. That realization has begun to change the way business executives make decisions about insurance, the way

²⁶Gleick, *Chaos* 6.

²⁷Gleick, *Chaos* 37.

²⁸Gleick, *Chaos* 2.

²⁹Hayles offers a more detailed analysis of the ways in which Gleick draws his characters, with particular reference to gender issues. Hayles, *Chaos Bound* 171-74.

astronomers look at the solar system, the way political theorists talk about the stresses leading to armed conflict.³⁰

The references to business executives and political theorists enlarge the scope of Gleick's subject beyond the bounds of what would normally be considered science, and forcefully demonstrate that he considers chaos to mark a wide-ranging shift in world-view. I will delve deeper into Gleick's book in chapter five, exploring the characteristics that it shares with postmodern literature.

We do not have to look far, then, to find texts which support, to a greater or lesser degree, the history of science that I have described in section one of this thesis. The examples I have given do not formulate a canon in the sense of proposing a list of scientific texts which will illustrate the development of science. However they do imply a certain canon of scientific ideas which are used to explain the present state of science: Newton and Laplace represent early modern science, quantum physics is brought in to illustrate the first blow to this world-view, and chaos theory is used to represent a refutation of this view.

As with my work on the literary and literary-critical canons, it is worth emphasising, at the risk of being repetitive, that this is not the only accepted history of science. Indeed, it is in fact rather contentious and has been attacked for three things. Firstly, over-playing the importance of chaos (just another sort of science, standing alongside traditional approaches); secondly, misrepresenting chaos (follows the principles of traditional science, finding order where it was not seen before); and thirdly, appealing unashamedly to the scientifically illiterate (not too many difficult equations, and it has some nice things to say about butterflies). These criticisms may be justified but this is not the point.

The crucial point is that there is a significantly large part of our culture which presents chaos theory - and indeed other aspects of contemporary science - in terms which ally it with other postmodern discourses. It is with these discourses I am concerned, and it is the interaction of these different sorts of postmodern discourse which I will be exploring in the second half of my thesis.

³⁰Gleick, *Chaos* 5.

SECTION 1 CONCLUSION

In this section I have sought to demonstrate that despite the 'natural' division between the arts and the sciences which our culture has, for so long, assumed to exist, there are in fact parallel histories in each area. These histories are not necessarily 'right,' in the sense of being the only acceptable explanations for the changes that have taken place during the last three centuries, but they are fairly widely accepted and promulgated by certain postmodern discourses, and are therefore considerably influential.

When the histories I have described appear in the discourses of literature, science and literary theory, with which I have been concerned, we can see that they are linked by a common concern with the changing status of knowledge. Not only is each of these subjects concerned with knowledge, but they also describe knowledge as developing in remarkably similar ways, despite one or two differences. In essence, they follow the pattern that I sketched in my introduction, envisaging a change from a relationship between self and world based on the rational and confident approach described in Descartes' *Discourse on Method*, to a more complex interaction, analogous to that envisaged by Lyotard in *The Postmodern Condition*.

Charting these histories demonstrates that a more complex understanding of the culture is needed than that presumed by the 'two cultures' model: if science and literature really are completely separate then the detailed parallel developments which I have found between these supposedly isolated fields, should be impossible to find, barring some highly unlikely coincidences. Indeed, even if chance were at the root of these connections, the analogies that such histories immediately suggest would soon result in a complicating of the two-cultures model - writers, especially, respond to scientific or technological developments as though they have relevance to themselves.¹

In order to demonstrate the explanatory power of these histories of the postmodern, the second half of my thesis will use three case studies to demonstrate how they can inform our readings of literary and scientific texts, and give us an appreciation of the complexities of the literature/science relationship.

¹See, for instance, Tom Stoppard's response to chaos theory in *Arcadia* (London: Faber, 1993), and William Gibson's response to information technology in *Neuromancer* (1984; London: Grafton-HarperCollins, 1986), which I discuss in chapter six. Gibson's popularity, and the ways in which his portrayals of information technology have worked their way into contemporary discourses about the Internet (particularly through the notion of *cyberspace*, a word which he coined), also demonstrate the reciprocal process, whereby literary ideas come to change the cultural understandings of science and technology.

SECTION TWO

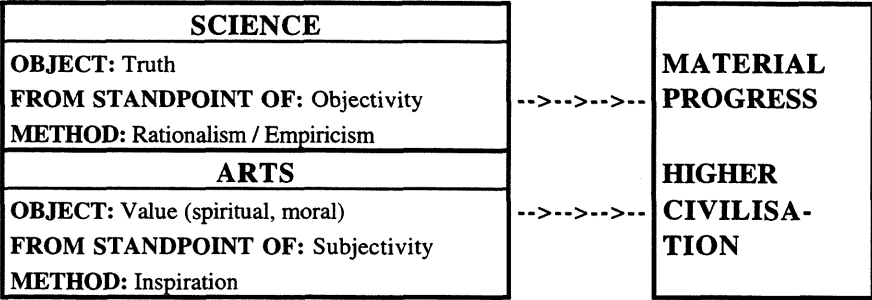
LITERATURE AND SCIENCE IN CONTEMPORARY CULTURE

SECTION 2 INTRODUCTION: STATEMENT OF THEORETICAL PRINCIPLES

Underpinning this thesis, and fundamental to it, is a certain model of culture. I have alluded to this model many times, and it forms the foundation upon which much recent literature/science criticism is based. However, its main principles often go unstated, so I will offer a brief description of it here.

The best way of explaining it is by contrast with the (again, often unspoken) model of culture it replaced, that of the ‘two cultures.’ I have alluded to this many times as well (particularly in the section on I.A. Richards in chapter one), but a brief summary of its key features will lay bare the ways in which our assumptions about how the culture is structured have changed, and how these changes have enabled certain ways of speaking about science and literature.

The 'two cultures' model depends on a basic visual metaphor, in which the culture is neatly split down the middle, divided between scientific and artistic territory. There is a fundamental difference between these two sorts of terrain, but when the culture as a whole is functioning properly, both pull in the same direction in the interests of human progress towards higher civilisation. The pursuit of science and of the arts may therefore be said to be complementary activities in this view of the culture, and we may characterise it with the following diagram:



This is, of course, schematic, and there are complicating cases. For instance, the presentation of the arts in this case probably draws most from Romanticism. The naturalism advocated by someone like Emile Zola would suggest that a more objective understanding of the world is possible if writers present it as it really is. Nevertheless, the general distinction between literature and science pointed to here, is broadly accurate in its characterisation of a certain view of the culture.

Because the arts and the sciences are perceived, in this view, to be concerned with fundamentally different sorts of terrain, there is only a little contact between them. In the terms of the above diagram, all interaction must, by necessity, be from top to bottom - because science is seen as an absolute and verifiable form of truth, it cannot be acted upon by the subjective, unverifiable truths dealt with by the arts. It, however, can have an influence upon the arts, but this influence is of a rather banal quality - as science makes its discoveries, some of these will be 'exported' down to feature as either foreground or background material for artistic enterprises. In other words, scientific ideas may be the ostensible subject of a piece of literature (though that literature cannot, legitimately, pass comment on the truth or otherwise of its scientific content), or the world-view that a scientific theory or discovery dictates, might exist as an assumed truth, as the cultural wallpaper, of a piece of literature.

My diagram does not include literary theory. In fact, the status of literary theory can vary in the model of the culture I have sketched above, depending on how its function and success are defined. If it is just seen as a particular form of opinion about literature - as a series of ultimately unprovable statements in an unending debate about literature - then it falls into the artistic terrain, as something generated as a by-product of literature. If, on the other hand, it is seen as an objective appraisal of literature, which lays bare certain truths about it, then it falls into the scientific terrain - literature becomes a stable object of study, not dissimilar to the regard in which the natural world is held by science, and literary criticism becomes a scientific appraisal of that object of study. This latter view is the one Richards might have had of literary criticism - his insistence on the objectivity of the critical method can therefore be seen as an attempt to emulate the methodology and success of science, and his assumption that all art can be sorted into 'high' and 'low' categories can be seen as a classificatory zeal which mirrors that of some scientific enterprises. Structuralism, of course, takes this perception of the role of literary criticism as a science much further.

The view of culture which has, at least in some quarters, replaced that described by the above diagram, cannot be so succinctly summed up in a picture. This is because it abandons the notion of separate terrains. Instead of being a terrain which naturally divides into two basic compartments, culture is seen instead to be comprised of all the stories that we tell about ourselves to explain who we are. It is, in other words, comprised of a number of discourses, and all knowledge that we have is seen to be mediated through, and made possible by, these discourses. The difference between literature and science is not so fundamental, in this view, because science is itself seen as a discourse.

The term discourse, as I am using it, has three main interwoven characteristics. Firstly, it implies a manifestation of power as a consequence of its deployment (perhaps, for instance, as a result of a claim to truth within a particular discourse).

Secondly, it operates as a sort of unspoken narrative, a story which is taken as so fundamental as to generally pass unchallenged when it is invoked by a specific narrative. Finally, and importantly, it makes other narratives possible (this is perhaps where its power lies) because it embodies all those assumptions which are fundamental for the working of those narratives.

The difference between narrative and discourse might be defined as the difference between a specific text, and the assumptions which it is necessary to make in order for that text to have meaning. We might go further and suggest that *narrative* is what is spoken, and *discourse* is what remains largely unspoken. This is not wholly the case and there is certainly a sense in which discourses can be spoken. Nevertheless, the distinction is quite useful and can be illustrated by reference to the example of the core literature/science discourse which I identified in section one.

The *narratives* are all those individual texts which I referred to - I.A. Richards' books and the other literary criticism I made reference to, and the novels and science writing which I cited. The *discourse*, on the other hand, is that system of meaning which links all those narratives together: the three-phase literature/science history that I identified. We might think of a narrative as a horizontal line, representing the experience of the reader as s/he moves through the linear sequence of the words upon the page. This line is scored across by many vertical lines, each denoting a discourse which is drawn upon by the narrative in order to give it meaning.

So when I say that science is a discourse I mean that it is a potent part of our culture, giving meaning to a large number of narratives. Of course, there is a danger of reifying the notion of discourse when we start to speak of it in these terms. It is important to make the obvious point, therefore, that discourse is not anything which exists 'out there' in any physical sense. A discourse, as far as we can define it, is a story which is key to the systems of meaning to which our culture subscribes. It is not pre-existent, and although it makes individual narratives understandable, and is therefore key in making them possible, it is also constituted by those narratives. Discourses are, as a result of this property, open to change - a narrative might draw upon a discourse but it will also, as soon as it is read, become one of those narratives which makes up the discourse, and may contribute to how that discourse is understood in the future.

This would seem, at least at first, to constitute an attack upon science's claims to truth: if science is a discourse then the rigid notions of truth upon which it seems to depend can no longer hold sway. However, I would not wish to leave this statement unexamined. It is not difficult to find ways in which science does operate as a discourse in the sense in which I have defined it. However, this does not mean that science is all discourse and nothing else. For the purposes of this thesis, this problem

can be overcome by splitting science into two broad categories: *professional science* and *cultural science*.

Professional science is that set of practices, texts and theories which constitute the world of practising scientists. Notions of truth are open to debate within professional science - philosophers of science have, for instance, called into question the absolute objectivity of the observing scientist, and the inadequacies of the languages of rationalism which are used by scientists. However, there is no consensus upon the subject. Indeed, many scientists regard such criticisms as an attack upon the integrity of their work by those who do not really understand it in enough detail to pass comment.¹

Trained only in the study of literature, I am not qualified to engage in this debate. Nevertheless, the other aspect of science, cultural science, is open to analysis from the humanities. It is constituted by every public utterance of science, be it by scientists themselves or by non-scientists. Whether these utterances are true or not - whether, for instance, popular science can ever really adequately portray the reality of science - is not the question. I am concerned with how science is represented and what these representations say, not whether they are accurate or not. It is in these public utterances of science, these narratives of science to which we all have access, that we can find wider-ranging cultural discourses. Of course, in the definition of discourse which I have used, it is seen to be malleable, open to change from each new narrative which draws upon it. In this sense, therefore, cultural science may be said to be a participating discourse in our culture, shaped by and shaping the stories by which we know ourselves. Because so much cultural science is an attempt by scientists to communicate professional science to an uninitiated public, we might say that professional science participates in the culture through translation - from a language of specialism to a language of generalism.

These scientific discourses are highly important because they are so numerous, and they are perhaps so numerous because they deal with issues which seem so crucial for an understanding of ourselves - for instance, who we are and where we come from. It is for this reason that I am interested in both them, and the ways in which they interact with the narratives of literature.

Finally, before going on to look at some specific examples of these interactions, it is perhaps important to briefly elucidate the assumptions I am making about language and about how language works. I said a little bit about this at the end of chapter three. It might be thought that, because I am adopting a model of culture in which it is

¹For an example of this viewpoint see Lewis Wolpert, *The Unnatural Nature of Science* (1992; London: Faber, 1993). Wolpert argues that science is far from being the commonsensical activity that the public often presume it to be.

assumed to be composed of various discourses, I might be tempted to adopt a structuralist approach to language and to the problem of identifying the links between literature and science, trying to find the deep structures which generate the discourses drawn upon by literature and science. This is, in fact, only partly the case. The problem with this approach is the same problem which afflicts all structuralist approaches: it reifies the notions of meaning and of structure, placing meaning at the centre of an imaginary structure (which is, however, analysed as though it exists in an objective sense) and assuming that this inner core of meaning somehow generates individual utterances through the channels defined by the structure.

Poststructuralist criticisms of this notion have focused on the impossibility of ever reaching this centre, arguing that whenever you approach it, whenever you begin to describe the middle of the structure, it is deflected away somewhere else because you then have to presuppose a structure which has generated that centre; you then presuppose another centre where meaning really lies, but as you approach this you encounter the same problem. The implications of this sort of criticism are that meaning is never attainable, remaining out of reach because it is deferred elsewhere whenever you approach it.

Although I agree with this criticism of structuralism and would wish to distance myself from a position which sought to find a deep structure, operating as a sort of metanarrative, determining all the other narratives in our culture - and, indeed, would rather embrace a view in which various, constantly-changing discourses compete within the culture - I do not wholly accept the alternative proposed by the poststructuralists. This is because the poststructuralist viewpoint entails, if it is carried to its logical extreme, a complete denial of the possibility of meaning.

By talking about meaning as something which is constantly deferred whenever we approach it, the poststructuralists invoke a visual metaphor which pictures meaning as something which exists as, and resides at, a point, slipping away from us every time we try to grasp it. Every time we try to define exactly what we mean, what we are trying to say slides off and away from the chain of words that we use.

The problem with this argument, and with the visual metaphor which it invokes, is that it should make all communication impossible (we can never reach the meaning of an utterance because it always moves away from us). This is manifestly not the case: although, as poststructuralists claim to have shown, all texts deconstruct when subjected to close scrutiny, this does not, in practice, seem to happen. What poststructuralism actually shows is the impossibility of defining meaning completely, not the impossibility of meaning itself. By deconstructing texts and exposing their inconsistencies, therefore, what are really being exposed are the inadequacies of our attempts to verbalise meanings, and the openness of all texts to more than one interpretation. This does not mean, however, that just because there are inevitable

linguistic inconsistencies in a text (and because it can be made to be read in a way opposite to its ostensible intention), that it does not have any meaning at all, nor indeed that it is impossible for people to read a text in ways which are broadly similar.

To suggest that a deconstruction of a text makes other readings of it impossible to sustain, and irrelevant, is to impart a mystic force to literary criticism which is wholly insupportable for two reasons. Firstly, it suggests that once a poststructuralist reading has been made then it is mystically spread amongst all future readers of the text by a process of osmosis (the text can no longer have meaning, regardless of people's individual reading experiences, because we have shown it to be inconsistent); and secondly, because it suggests that the poststructuralist reading somehow supplants and makes void other ways of reading the text.

This all comes back to the inadequacies of the 'point of meaning,' as an apt visual metaphor for the status of meaning in the text, implied by poststructuralism: if I can show that meaning is at some other point, then it is not at this point. It would be much better to think of meaning as an elastic substance: new readings of a piece of literature do not necessarily replace other readings (though they might, conceivably, do that), but instead stretch meaning so that it exists in more than one place at a time. Rather than being deferred to another point, therefore, meaning is stretched to cover a number of points.

This is relevant to the thesis because what I am attempting to do is to show how there is a meaning latent within the texts, which I will study in section two of the thesis, that ties them in with scientific discourses. This meaning does not replace other meanings but sits beside them. The meaning we derive from these texts is therefore stretched to encompass the scientific concerns which illuminate the literary texts, and the cultural concerns which illuminate the scientific texts.

The sense of an elastic meaning allows us to account for texts' ability to sustain a number of mutually contradictory meanings at the same time, not only by different readers but also by the same reader. The poststructuralists' insistence on the deferred nature of meaning would imply that, once we had accepted the principle that we can never pin meaning down to one place, we should assume that texts have no meaning at all; by talking about meaning as something which is stretched, on the other hand, we can embrace both the instability of texts and the sense that they do have meanings of various sorts. I am focusing on one sort of meaning - that endowed by the literature/science discourse - which helps us understand the ways in which literature and science are bound together.

An additional point is that, if meaning cannot be pinned down or rendered with absolute accuracy by language, as the poststructuralists have shown, and yet meaningful interchange does take place, then perhaps this illustrates that meaning is not wholly linguistic. Meaningful interaction takes place despite the multiple meanings of

all spoken and written utterances. To confine our understanding of meaning to something that is formed only by arbitrary semiotic systems would therefore be wrong.

In *The Language Instinct* Stephen Pinker argues this point forcibly, proposing an understanding of language as something which is a biological capacity shared by all humans, not just the product of a particular cultural milieu. This perhaps suggests an insight which we are loathe to acknowledge in the humanities: language might have biological as well as cultural dimensions. Furthermore, Pinker suggests that we cannot reduce thought (and hence meaning) to a by-product of language: our language does not wholly determine what we can think.

He neatly summarises the prevailing view with which he disagrees: 'people's thoughts are determined by the categories made available by their language. . . . The implication is heavy: the foundational categories of reality are not "in" the world but are imposed by one's culture. . . .'² He then goes on to offer an example of the sort of argument that this leads to, which will be familiar to anyone who has participated in a seminar about structuralism, or tried to explain Saussure to undergraduate students:

physicists tell us that wavelength is a continuous dimension with nothing delineating red, yellow, green, blue, and so on. Languages differ in their inventory of color words: Latin lacks generic 'gray' and 'brown'; Navajo collapses blue and green into one word. . . . You can fill in the rest of the argument. It is language that puts the frets in the spectrum. . . .³

The problem with this argument, Pinker claims, is that it generalises out from an incomplete understanding of the ways in which colour-recognition works. Light might well exist in a continuous wavelength, but this is not how the eyes interpret it:

Eyes do not register wavelength the way a thermometer registers temperature. They contain three kinds of cones, each with a different pigment, and the cones are wired to neurons in a way that makes the neurons respond best to red patches against a green background or vice versa. . . . No matter how influential a language might be, it would seem preposterous to a physiologist that it could reach down into the retina and rewire the ganglion cells.⁴

As a result, languages 'may disagree about the wrappers in the sixty-four crayon box,' but they 'agree much more on the wrappers in the eight-crayon box - the fire-engine

²Stephen Pinker, *The Language Instinct: The New Science of Language and Mind* (1994; London: Penguin, 1995) 57.

³Pinker 62.

⁴Pinker 62.

reds, grass greens, lemon yellows.’⁵ Pinker goes on to point out that if a language has only two words for colour, they are for black and white, that languages with three words always add in red, and so on. Furthermore, peoples brought up in cultures with only two words for colour, were always quicker to learn a ‘new color category that was based on fire-engine red than a category based on an off-red. The way we see colors determines how we learn words for them, not vice versa.’⁶

What all this illustrates is that it is not sufficient to assume, as the poststructuralists do, that all thinking is entirely linguistic and based on an arbitrary division of reality by a signifying system. They expose the limits of pure rational enquiry, but ignore the biological systems which help us to interpret the world - it is not enough to say that our appreciation of colour is solely determined by culture.

To prove that linguistic meaning is not wholly stable, is therefore not the same thing as proving the instability of all meaning - in the example I have taken from Pinker, it is clearly insufficient, if he is right, to say that colour is knowable only through the lenses of our culture. His further implication, that language has little or no shaping influence upon thought, is much less convincing - and is perhaps overstated in order to make the case against the traditional tide of opinion in the social sciences.

What does stand scrutiny is the argument that meaning, though hard to pin down precisely in a text, and though interpreted differently by different cultures and different individuals within cultures, does exist in a form which is stable enough for us to talk about it. By raising these issues I am trying to draw out exactly how I understand the model of culture as composed of different discourses to operate. I see the discourses which define our culture to be open to change, and I also see them as constituting, to a degree, our understanding of the world. This avoids a position of complete relativism because it is possible to talk about truth being refracted through different systems of meaning, different discourses, without being destroyed by them. We cannot approach a position of absolute truth but we can achieve more adequate descriptions of the world - adequate in the sense of rendering it with sufficient clarity for it to make sense to those who share our systems of interpretation.

The histories of literature, science and literary theory that I have described are specific to our culture, and define themselves by virtue of their differences from Enlightenment discourses. The second section of the thesis will use three case studies to demonstrate how these histories can provide a foundation upon which we can build our understanding of literature and science in contemporary culture. Each chapter will deal with a different issue in turn, focusing on literary and scientific texts in order to see how their engagement with the issue in question is bound up, one with the other.

⁵Pinker 62.

⁶Pinker 63.

Because I have broached the issue of knowledge so directly in the first section of the thesis, it is with this that I will begin the second section, focusing on Thomas Pynchon's *Gravity's Rainbow*, James Gleick's *Chaos*, and Ilya Prigogine and Isabelle Stengers' *Order Out of Chaos*. We will find a common concern lying in their destabilisation of binary oppositions between order and disorder, and global and local. The following chapter will home in on one aspect of the issue of identity, exploring the ways in which William Gibson's novels and Richard Dawkins' books about evolution, throw into question the strict distinction between natural and artificial assumed during the Enlightenment. The final chapter will compare Kurt Vonnegut's novels with Stephen Jay Gould's discussion of palaeontology and evolution in *Wonderful Life*, in order to demonstrate the renunciation of teleology in postmodern discourses.

The overall aim of these case studies is to produce a more general understanding of the sort of world-view associated with postmodern literature and science. I am therefore aspiring to provide a framework for understanding some aspects of contemporary culture, not a comprehensive analysis of it.

CHAPTER 5: DISCOURSES OF KNOWLEDGE

Because the first section of the thesis concentrated so directly upon the changing status of knowledge, in order to map parallel developments in literature, science and literary theory, it makes sense to use my first case study to explore this issue of knowledge in a broad sense. We will find postmodern discourses opening up territory which was not explored by Enlightenment narratives by disputing binary distinctions which had seemed fundamental to the Enlightenment, most particularly those of order/disorder and global/local. By suggesting that there is a middle ground between each of these polar opposites (that, for example, things do not have to be either ordered or disordered, but can be a subtle mixture of the two), they formulate new sorts of knowledge, and new ways of articulating that knowledge, which were previously unthinkable. The texts I shall focus on to illustrate this are Thomas Pynchon's *Gravity's Rainbow*, James Gleick's *Chaos*, and Ilya Prigogine and Isabelle Stengers' *Order Out of Chaos*.

Gravity's Rainbow is a suitable novel for this sort of study because it is often cited as a key text of the postmodernist era. For instance, Edward Mendelson suggests that it is an 'encyclopedic narrative,' one which attempts 'to render the full range of knowledge and beliefs of a national culture, while identifying the ideological perspectives from which that culture shapes and interprets its knowledge.'¹ This makes it a highly relevant novel to focus upon, because it is seen to articulate a new cultural identity.

Although the term *postmodern* was not a critical commonplace when Mendelson was writing, the key features which he associates with Pynchon's text are those which came to be seen as being key to postmodernity. These are a sense of a new international culture, transcending traditional geographical boundaries via innovations in high-speed communication technologies, and a concern with an economy which is grounded upon information, not material goods: 'Pynchon's international scope implies the existence of a new international culture, created by the technologies of instant communication and the economy of world markets. . . . The distinguishing feature of Pynchon's new internationalism is its substitution of data for goods.'²

Admittedly, there are problems with Mendelson's argument, especially in its reification of the notion of culture, and its implication that it throws up one, and only one, encyclopaedic narrative at moments of crisis, in some sort of deterministic

¹Edward Mendelson, 'Gravity's Encyclopedia,' *Mindful Pleasures: Essays on Thomas Pynchon*, eds. George Levine and David Leverenz (Boston: Little, 1976) 162.

²Mendelson 164-65. The importance of these new technologies, and of how they shape the way in which we see the world, will be a central concern of chapter six.

fashion. This suggests that the narrative is produced directly by the culture, or by a writer mystically 'chosen' by the culture, rather than that it is something written by an author who is struggling with his or her culture's sense of self.

Nevertheless, Mendelson's argument is generally sound, and his contention that these encyclopedic narratives 'appear near the beginning of a culture's or a nation's sense of its own separate existence,'³ and that they originate in 'moments of hierarchical strain and cultural distress,'⁴ are extremely useful. They suggest, as I shall argue, that *Gravity's Rainbow* responds to a new cultural climate and new definitions of knowledge, and is concerned with how we know ourselves through postmodern discourses.

Another reason for choosing Pynchon's novel is that it was published before the term *chaos* was coined to describe corresponding developments in various sciences, and a decade before chaos theory began to penetrate the popular imagination. We therefore avoid the trap of finding analogies to chaos theory in *Gravity's Rainbow*, merely because they are self-consciously alluded to in the novel. Any parallels that we find will be indicative of a genuine shift in the status of knowledge, not just the result of Pynchon self-consciously alluding to a contemporary science which he finds interesting.

Chaos theory is a good subject to place alongside *Gravity's Rainbow* because, as I have already shown, it is located in the third phase of the core literature/science discourse by many of the canons constructed by postmodernism. The particular explanations of chaos which I have chosen to focus on demonstrate the advantages of looking at presentations of science which are aimed at a general audience. For one thing, they inevitably reach a wider readership than more technical articles. Thus, while they may not be as important for the actual development of a science as scientific papers which are read by a small but expert community, they can be said to be more influential in terms of forming the public perception of that science. Whilst they are obviously themselves in debt, to a degree, to more technical scientific papers, it is, then, reasonable to suggest that they contribute more directly to the discourse of science which runs through, and influences, our culture.

Gleick's book is one of the best selling and most influential of the presentations of chaos theory which line the popular-science sections of book shops. Prigogine and Stengers' work is probably less well known. Nevertheless, it has been translated into twelve languages and, because it deals with a different aspect of chaos theory and employs markedly different rhetorical strategies from Gleick's work, it provides an

³Mendelson 164.

⁴Mendelson 174.

important illustration of another route down which discussions about chaos theory can travel.

According to Katherine Hayles, the basic difference in the content of the two books is that, despite many points of convergence, Gleick's mainly deals with work that finds order within systems which had seemed to be disordered; whereas Prigogine's deals with systems which actually are disordered, but which spontaneously organise themselves into an ordered form.⁵ The mode of argumentation also differs significantly between the two works.

I have already alluded, in chapter four, to Gleick's dependence on the motif of the 'man alone,' which is so entrenched in much American culture, to sketch the characters of his scientists. Much of the rhetorical power of his work is achieved by invoking these sorts of popular cultural references, and they are organised in a highly complex way in the text.

Prigogine's work, on the other hand, adopts a much more philosophical tone, using chaos theory as a point of departure for musings upon the reconciliation of being with becoming.⁶ Indeed, it is reasonable to suggest that much of the difference between the two works is consequent upon the roots of one in American culture, and of the other in the traditions of a European continental philosophy - characterised by references to the eclectic musings of historians of science and culture like Michel Serres, and different in degree from Gleick's work, much as the writing of Julia Kristeva and Hélène Cixous departs from the mainstream of Anglo-American feminist criticism.

Despite these very important differences, both fit into the history of science I described in section one of the thesis. One of the reasons they provide such compelling evidence for the existence of this history as an influential force, is that they are aimed at the general reader. In the process of both simplifying and justifying themselves for this inexpert audience, they have a tendency to lay bare, and state explicitly, the prime assumptions that they make about the position of their science in relation to that of previous scientific enterprises.

⁵For a more detailed explanation of these differences see Hayles, *Chaos Bound* 9-11. For ease of reference, I refer here and elsewhere to *Chaos and Order* as Prigogine's book. This seems to be common practice, and Ilya Prigogine is the better known of the two scientists, but this is not meant in any way to devalue Isabelle Stengers' contribution to the book, and she is implied in all my references to Prigogine.

⁶For definitions of *being* and *becoming* see my discussion of Prigogine on page 114. Hayles comments, at the beginning of chapter 4 of *Chaos Bound*, that Prigogine's work often extrapolates beyond what many chaos theorists would be willing to grant as legitimate conclusions, drawn from the data. This is ironic, given that popular science books are often condemned for failing to appreciate the limits of the subject when they are written by journalists like Gleick: Ilya Prigogine won the Nobel Prize in 1977 for his work on dissipative structures.

These, then, are the texts which will anchor my discussions about postmodern literature and science in relation to broad questions of knowledge. They also all portray the coming-into-being of the postmodern discourses which they embrace, constructing a history for themselves which in some sense mirrors that which I described in section one of the thesis. I will begin with this history, drawing out the ways in which the texts I am discussing postulate a 'revolutionary moment,' when the old ways of knowing were replaced by the new ones. Because there is this juxtaposition of old and new ways of knowing, the move from modern to postmodern is sometimes represented as a point of crisis in our epistemologies. Having discussed this, I will then go on to explore the disruption of the order/disorder and global/local binary oppositions.

The Revolutionary Moment: *Gravity's Rainbow* and Chaos Theory

Our working hypothesis is that the status of knowledge is altered as societies enter what is known as the postindustrial age and cultures enter what is known as the postmodern age. This transition has been under way since at least the end of the 1950s. . . .⁷

This statement from Jean-François Lyotard tallies with the shift from the modern to the postmodern which I identified in chapter three, and requires two things of a postmodern discourse: that it register a shift in the status of knowledge, and that this shift be shown to take place in the second half of the twentieth century. Similarly, Katherine Hayles' *Chaos Bound*, probably the most comprehensive description of the rise of the importance of chaos theory in literature and science, describes postmodern culture as an evolving denaturing of experience during the twentieth century. A crucial moment comes with the Second World War, when the need to coordinate rapid troop movements across varied theatres of conflict, in effect 'made information real.'⁸ This, and other twentieth-century developments, led to the rise of postmodernity, especially during the second half of the twentieth century.

I have already quoted from *Chaos* in chapters three and four in order to show how Gleick's work identifies a shift in knowledge which takes place in the second half of the twentieth century, with the development of chaos theory in the 1960s, 1970s and 1980s. The significance with which he invests this shift is summed up by a bold assertion in the prologue to *Chaos*: 'Where chaos begins, classical science stops.'⁹

⁷Lyotard 3.

⁸Hayles, *Chaos Bound* 269.

⁹Gleick, *Chaos* 3.

Gleick implies a particular moment when the chaos revolution finally came into its own: the first chaos conference, described in chapter six of the book, 'Universality.' It is worth looking in detail at the rhetorical strategies which Gleick employs in this chapter, because they give us a sense of the significance with which he invests the revolution he describes.

The first five chapters of the book outline scientists' enquiries into various phenomena, which paved the way for chaos theory. However, Gleick emphasises that at this stage the field was highly disparate - scientists pursued their investigations alone, they were mostly unaware of similar breakthroughs being made in other disciplines, and their colleagues did not appreciate the importance of their work. It is in chapter six that things finally come together.

Here, we finally return to Mitchell Feigenbaum, whom Gleick portrayed as an alluring but mysterious figure in his prologue. This is the Feigenbaum whose description by Gleick (the 'ragged mane' of hair, and the 'sudden and passionate' eyes) I referred to in chapter four. The reader could gather from the prologue that he was an important character, but quite why he was important was not made clear. All is revealed in chapter six. Gleick returns to Feigenbaum and reveals to the reader that it was he who discovered a 'universal theory' which 'made the difference between beautiful and useful.'¹⁰

After this, the first chaos conference takes place in 1977, in Como in Italy, 'a stunningly deep blue catchbasin for the melting snow from the Italian Alps.'¹¹ The idyllic setting functions as pathetic fallacy in the text, highlighting the new-found confidence and identity of the new science, and we are told that the delegates were 'weepingly grateful'¹² to find others pursuing similar research in different fields.

Feigenbaum figures in lengthy anecdotes at the beginning and the end of this pivotal chapter in Gleick's book. He is brought in as the figure who draws all the other stories about chaos together. At the end, after the Como conference has been described, he is presented as being at ease, talking to an interviewer (presumably Gleick) as he smokes cigarette after cigarette and muses upon the links between art's approach to the world, and that of chaos. The earlier anecdotes, at the beginning of the chapter, are especially interesting because they suggest that chaos is made possible by a new sort of scientific approach, and perhaps even a new sort of scientist. This new approach is described as drawing upon Romantic influences.

¹⁰Gleick, *Chaos* 180.

¹¹Gleick, *Chaos* 184.

¹²Joseph Ford, quoted in Gleick, *Chaos* 184.

As we begin the chapter, Feigenbaum is strongly associated with nature. He stands a little upstream from a waterfall, and speculates about the recurring patterns of foam on the water's surface, realising that science has no way of expressing these sorts of phenomena. After a little detail about the problems facing scientists at the time, and how Feigenbaum came to be hired by M.I.T., we flash back to Feigenbaum's experience as a graduate student at M.I.T. and, in particular, an epiphanic episode by the Lincoln Reservoir in Boston. Visiting the reservoir with some friends, he becomes detached from the group and begins to speculate about the precise distance at which it becomes impossible for him to understand the conversations of neighbouring groups of picnickers. Inspired by his 'Romantic inclinations,'¹³ this crucial moment leads him to dwell upon the transition from intelligibility to unintelligibility, and other problems of human perception.

These ponderings link us into Feigenbaum's insights into an early nineteenth-century dispute about the nature of light between Goethe and Isaac Newton's followers. Newton's theory saw each colour as a certain wavelength of light, whereas Goethe argued that 'color is a matter of perception.'¹⁴ Newton's optics eventually proved themselves right of course, but Feigenbaum nevertheless tracked down a copy of Goethe's relevant treatise and 'persuaded himself that Goethe had been right about color.'¹⁵ Gleick ends this anecdote with a description of the crucial insight which Feigenbaum got from all this:

Redness is not necessarily a particular bandwidth of light, as the Newtonians would have it. It is a territory of a chaotic universe, and the boundaries of that territory are not so easy to describe - yet our minds find redness with regular and verifiable consistency. . . . [T]o understand how the human mind sorts through the chaos of perception, surely one would need to understand how disorder can produce universality.¹⁶

Feigenbaum's eventual contribution is not to alter theories about the behaviour or substance of light. Nevertheless, Gleick uses this episode to demonstrate a different way of looking at problems which eventually produces the key breakthrough in chaos theory: Feigenbaum's universal theory. What is interesting about it, is that it shows Feigenbaum going back to the father of modern science, rejecting his view, and

¹³Gleick, *Chaos* 163.

¹⁴Gleick, *Chaos* 164.

¹⁵Gleick, *Chaos* 165.

¹⁶Gleick, *Chaos* 166.

exploring a different path, the Romantic path, which was not taken by science and which was regarded as 'pseudoscientific meandering.'¹⁷ Feigenbaum understands that there is 'true science' in Goethe's theory of colour, and thus allies himself with a key Romantic figure.

Gleick does not, by any stretch of the imagination, suggest that Newtonian science, and all that came from it, was wrong here. What he does do, is imply that the chaos theorist has to look at things in a radically different way to the practitioner of classical science. The identity of the scientist has, in some degree, to change. This identity is recast in Romantic terms, by virtue of the references to Goethe in chapter six of *Chaos*, and the descriptions of the chaos theorists themselves as men (they are all men in Gleick's book) who work against the grain of traditional science.

What we are presented with, in this chapter of Gleick's book, is a moment when the revolution crystallises - the 1977 Como conference - and a figure who represents the revolution, and who was able to produce the key theory which linked its disparate strands together, by having the courage to go back to the dawn of modern science, and think things through in a different way. Feigenbaum becomes an icon of the new science, a symbolic figure who renounces the old ways and clears the way for the new.

The case of Prigogine's work, in relation to this need to postulate the move from classical to 'postmodern' science, is rather more complicated. This is because he locates the first challenge to classical science with a nineteenth-century development, the second law of thermodynamics. This contradicted the time-reversible principle of classical physics by suggesting that entropy (disorder) always increases - in other words, it made time flow in one direction. This is a key development for Prigogine because he situates his work as a reconciliation between classical notions of reversible time (being), with the sense that time flows in one direction (becoming). In fact, it is this reconciliation of being with becoming which allows us to slot Prigogine's work into the same late twentieth-century framework as *Gravity's Rainbow* and *Chaos*, because it is a reconciliation which takes place during the last few decades.

Indeed, Prigogine even mirrors the pattern I identified in chapters three and four of locating relativity theory and quantum mechanics as moments of crisis in classical physics, and then invoking chaos theory as the final crisis which undoes, once and for all, the presumptions of traditional science: 'At the end of the twentieth century we have learned to understand better the meaning of the two great revolutions that gave shape to the physics of our time, quantum mechanics and relativity.'¹⁸ This phrase suggests

¹⁷Gleick, *Chaos* 164.

¹⁸Prigogine 9.

that it is only now, after the work of scientists like Prigogine, that we can appreciate the true role of relativity and quantum mechanics in the history of science, as it developed towards the insights made by chaos theory. Gleick also, it should be noted, reproduces this pattern, commenting that some advocates of chaos theory claim that,

twentieth-century science will be remembered for just three things: relativity, quantum mechanics, and chaos. . . . Like the first two revolutions, chaos cuts away at the tenets of Newton's physics. As one physicist [Michael F. Shlesinger] put it: 'Relativity eliminated the Newtonian illusion of absolute space and time; quantum theory eliminated the Newtonian dream of a controllable measurement process; and chaos eliminates the Laplacian fantasy of deterministic predictability.'¹⁹

Gravity's Rainbow also registers a shift in the status of knowledge, locating it quite specifically during the Second World War. The actual nature of the new mode of knowledge appears in the novel's form, and more specifically in the style of science practised by Roger Mexico, which is contrasted with that of Ned Pointsman. I will discuss both these things in more detail later on in the chapter. For the moment, I will concentrate solely upon the way in which the Second World War is situated as a key moment in history.

This appears most dramatically in the form of the Zone, the open, anarchic state of Europe after the defeat of Germany and before the end of the war. This Zone is described as setting the stage for what will follow from the war - a key moment when history could take any one of a number of directions. The origins of the post-war world, and the postmodern world, lie in the Zone. For instance, Mr Information, a highly bizarre personality in a novel of freakish characters, describes the war as a set of railway points in history that will throw the post-war world in one direction or another.²⁰ Slothrop, the central protagonist, also sees the Zone as crucial, sensing that 'maybe for a little while all the fences are down, one road as good as another, the whole space of the Zone cleared, depolarized, and somewhere inside the waste of it a single set of coordinates from which to proceed, without elect, without preterite, without even nationality to fuck it up.'²¹

¹⁹Gleick, *Chaos* 6.

²⁰Pynchon, *Gravity's Rainbow* 644-45. The image of railway tracks is a dominant motif in the novel. The sense of a dense network of tracks recalls chaos theory's doctrine of sensitivity to initial conditions: the train's course along the tracks is completely determined by the points over which it travels, but if just one set of points are thrown in another direction, the train may end up somewhere completely different.

²¹Pynchon, *Gravity's Rainbow* 556.

Although there is immense potential in the Zone, it could set history off in any one of a number of directions, positive or negative. Consequently it is presented as a determining historical phenomena which inspires both tremendous hope and great fear. This ambiguity is summed up neatly by the Argentine anarchist, Squallidozzi, who has travelled with his compatriots in the hope that the Zone will allow them to restart history from the right set of coordinates: "In the openness of the German Zone, our hope is limitless." Then, as if struck on the forehead, a sudden fast glance, not at the door, but *up at the ceiling* - "So is our danger."²²

So, the three core texts for this chapter all locate a fundamental shift that takes place during the twentieth century. I will show exactly what this shift entails for conceptions of knowledge, by exploring the ways in which they sabotage the strong Enlightenment distinctions between order and disorder, and global and local.

Mining the First Binary Divide: (i) From Disorder to Chaos in the Work of Gleick and Prigogine

Postmodern science - by concerning itself with such things as undecidables, the limits of precise control, conflicts characterized by incomplete information, '*fracta*,' catastrophes, and pragmatic paradoxes - is theorizing its own evolution as discontinuous, catastrophic, nonrectifiable, and paradoxical. It is changing the meaning of the word *knowledge*, while expressing how such a change can take place.²³

In referring to postmodern science, Lyotard does not necessarily mean exactly the same thing as I do by the term, and he certainly does not refer to chaos theory by name (indeed, as he was writing in 1979, it would have been highly surprising had he done so).²⁴ However, the words and phrases which he uses to characterise what he calls postmodern science take him towards a definition which is not that far removed from the one I have been trying to postulate, and he even mentions some scientists who are now strongly associated with chaos theory.²⁵ He certainly draws on - and, given

²²Pynchon, *Gravity's Rainbow* 265.

²³Lyotard 60.

²⁴The word *chaos* was first coined to describe the new science in 'Period Three Implies Chaos,' a paper by James Yorke and Tien-Yien Li in 1975, *American Mathematical Monthly* 82: 985-92. However, the term did not gain wider, popular recognition until the 1980s.

²⁵Benoit Mandelbrot receives significant attention in the text. Lyotard 58. Ilya Prigogine and Isabelle Stengers are mentioned in a footnote. Lyotard 56.

the influence of *The Postmodern Condition*, contributes to - the discourses of postmodern science which I have identified.

What is interesting is that he suggests that postmodern science, not only does science in a different way, but that in doing so it creates a complex history for itself - it does not just work according to constraints imposed by new conceptions of knowledge, it also implies something about the change to those new conceptions. In some sense, therefore, old and new ways of knowing are juxtaposed. This is exactly what we find happening in the three texts that I concentrate on in this chapter.

It happens partly for reasons that I have already talked about in relation to the equivalent revolutionary moments posited by the three texts: the two descriptions of chaos theory describe the coming-into-being of the science, and therefore explicitly describe the movement from old ways of knowing to new ways; and *Gravity's Rainbow*, as an encyclopaedic text, expresses a moment of crisis in the culture as it shifts into a new phase, and as a result brings discordant ways of knowing into close proximity with each other. It also happens because there is a difficulty in expressing new ways of knowing, when our language is so tightly regulated by the old ways. Consequently we find descriptions of chaos theory struggling for a way to express the new territory between order and disorder, and we find *Gravity's Rainbow*, in its contrast between the old science of Ned Pointsman and the new science of Roger Mexico, tussling with the difficulties of describing a science which has not even come into existence yet. I will start with this struggle as it appears in chaos theory.

It is manifested most obviously in the term *chaos* itself. What the theory does is redefine this word, trying to disassociate it from *disorder*, and complete opposition to *order*, and instead place it somewhere between these two terms. There is not a word in existence that really expresses the subject matter with which chaos theory deals, and so it has to take an existing term and deploy it in an unusual way.

This means that we get a clash between two languages for knowing the world. The first assumes a sharp binary distinction between order and disorder, and the second finds this distinction to be less meaningful, considering it necessary to find new ways of articulating the world. This is made apparent within Gleick's book, and in many other presentations of chaos theory, by the frequent juxtaposition of two words (or sometimes phrases) which have opposite meanings. Because the science deals with phenomena that cannot be accurately described by the binary oppositions which populate our language, two associated rhetorical tactics are deployed: two antonyms are harnessed as adjectives to describe the same noun; or, one word is deployed as an adjective to describe a noun, normally associated with an opposite meaning to that adjective. So, Mitchell Feigenbaum speculates that cloud formations are both 'random'

and 'not-random,' 'fuzzy and detailed,' and 'structured and unpredictable';²⁶ Edward Lorenz's work on 'deterministic chaos' produces a simulation of the weather which behaves according to a principle of 'orderly disorder,' and which can be described by a representation which signals both 'pure disorder' and 'a new kind of order';²⁷ Philip Marcus's model of the Red Spot on Jupiter's surface denotes a 'stable chaos';²⁸ James Yorke coins the term *chaos* to describe systems which operate according to the principle of 'deterministic disorder';²⁹ and Benoit Mandelbrot makes the insight that the world displays a 'regular irregularity,' while, in the Mandelbrot set, which 'commingles complexity and simplicity,' the 'irrational fertilized the rational.'³⁰

In Gleick's presentation of chaos theory, therefore, we do not get an impression of the new science of chaos as just another extension of scientific knowledge into new territory (though he does acknowledge that some scientists see it in this way). Instead, chaos seems to make problematic our fundamental assumptions about what knowledge is; it even exposes the inadequacy of our everyday language for describing these newly discovered phenomena. The term *chaos* has itself to be redefined, to mean 'that which is neither ordered nor disordered,' if it is to label the new scientific theories accurately.

A similar rhetorical strategy to Gleick's juxtaposition of words with opposite meanings, is Prigogine's emphasis on the reconciliation of being with becoming in his books. Certainly there is an emphasis on the revolutionary status of chaos theory which mirrors that in Gleick's work. For instance, the opening sentence of the preface claims that '[o]ur vision of nature is undergoing a radical change toward the multiple, the temporal, and the complex,' and a page later this process is described as a widespread 'conceptual revolution.'³¹ As in *Chaos*, therefore, there is an emphasis upon the distance between chaos theory and previous scientific methods and objects of study. This clash of opposing epistemologies is foregrounded by the devotion of large proportions of the book to the history of science since the seventeenth century. This draws our attention to chaos's position as a reworking of some fundamental ideas in classical science. It is important to point out that the history of science is presented as being much more fragmentary and contradictory than it is in Gleick's work - in general,

²⁶Gleick, *Chaos* 3.

²⁷Gleick, *Chaos* 139, 15, 30.

²⁸Gleick, *Chaos* 55.

²⁹Gleick, *Chaos* 69.

³⁰Gleick, *Chaos* 98, 221, 223.

³¹Prigogine xxvii, xxviii.

Chaos suggests a radical departure from classical science, whereas *Order Out of Chaos* suggests a philosophical reorganisation of some fundamental ideas.

This is brought out in both the subtitle of Prigogine's book, *Man's New Dialogue with Nature*, and in the original, French title of the book, *La Nouvelle Alliance*. The subtitle suggests a new interaction between humans and nature; the French title suggests a new interaction between the arts and the sciences; both imply that something completely new will follow from chaos theory.

So, although chaos is presented as a 'postmodern' science - as something which contradicts the presumptions of Newtonian science - as I showed earlier on in the chapter, some of the old ways of knowing are caught up in Gleick's and Prigogine's work, and there is not a completely clean break from traditional scientific principles (it is important to reiterate that there is an alternative history to the one I have described, and that some scientists deny that there is *any* break between chaos theory and classical science).³² But in what ways is chaos theory postmodern, and how exactly does it disrupt the distinction between order and disorder?

I have already mentioned the 'butterfly effect' in a previous chapter, but it is worth returning to it here, because it gives us a way of answering these questions. Gleick devotes his first chapter to this phenomenon (also known, more technically, as 'sensitivity to initial conditions'), and provides a good summary of its consequences through the story of the meteorologist, Edward Lorenz.

Lorenz, we are told, invented a simple, idealised computer simulation which modelled the world's weather with twelve equations. Importantly he is described as a 'god of this machine universe' who put 'into practice the laws of Newton, appropriate tools for a clockmaker deity who could create a world and set it running for eternity.'³³ In other words, Lorenz expects his simulation to behave according to the principles of Newtonian science - he has created a deterministic system, so it should function in a straightforward, deterministic way.

Yet what Lorenz finds is that even though his simulation captured the deterministic principles of the universe described by Newtonian science, there was something fundamentally unpredictable about how it would develop. If the starting conditions were varied only ever so slightly - by one part in a thousand - then the simulation would evolve in a radically different fashion, and the weather on his artificial world would quickly depart from its expected course. The insights which follow from

³²This alternative perspective on chaos theory is suggested in a review of Gleick's book by John Burrow, who argues that there has 'been no Kuhnian revolution here,' and that chaos theories merely extend the scientific enterprise into a new area because they are concerned with 'a *different* class of problems.' John Burrow, 'Making a New Science,' *New Scientist* 26 May 1988: 73, 74.

³³Gleick, *Chaos* 12.

both this and similar discoveries, constitute the main body of Gleick's text and involve a renunciation of three important principles of Newtonian science.

The first of these is a firm belief in the power of human reason to unlock the secrets of nature. Because science is used to studying linear systems which behave in a straightforward way, and are amenable to analysis, it takes on board the assumption that the whole universe behaves in a stable, orderly way. The second principle, which follows from this, is that of prediction: if everything can be known about a system, then we can predict how it will behave in the future. This accords directly with Descartes' belief, cited in the introduction to section one, that 'there can be nothing so distant that one does not reach it eventually,' and Laplace's contention, quoted in chapter one, that 'nothing would be uncertain' for the intellect which had enough information. The third principle is that of control: if everything can be known about a system, and if we can predict how it will behave, then we can alter the conditions under which it operates and control its future development. This does not mean that modern science knows, predicts and controls everything, but that in principle it is believed that these things are possible - they are ideals according to which modern science conducts its investigations.

The implications which follow from Lorenz's computer simulation contradict these principles directly. Firstly, very small inaccuracies that we have in our information about a system will always plague our measurements of it. To eliminate these discrepancies in the information we have, we would need to be able to measure it with infinite accuracy - an impossibility, because no matter how accurate our measurements are, there will always be a finer level below them which we do not take into account. This must have been accepted by modern science, but was thought to be unimportant because it was assumed that, in most situations, a close understanding of the system now would lead to a close understanding of the system in the future. However, secondly, these minute inaccuracies sabotage any hopes of making long-term predictions because very small-scale causes magnify to have large-scale effects in nonlinear systems (this is part of the disruption of the global/local opposition, which I will discuss later on in the chapter). This obviously also subverts our hopes of controlling a system - if we cannot predict how it will behave in the future, we cannot wholly predict what effects our attempts to manipulate the system will have.

So, although Lorenz's simulation operated according to deterministic principles which were known in their entirety - he had designed the twelve equations governing the system himself - it acted in a way which subverted the ideals according to which modern (classical) science went about its business. Gleick emphasises that, although it was known that there were limits on what we could know about the universe in practice, chaos theory demonstrates that nonlinearity is actually predominant, and that there are also theoretical limits upon our knowledge:

In science as in life, it is well known that a chain of events can have a point of crisis that could magnify small changes. But chaos meant that such points were everywhere. They were pervasive. In systems like the weather, sensitive dependence on initial conditions was an inescapable consequence of the way small scales intertwined with large.³⁴

In proposing chaos as a new sort of science, which unsettles three key principles of modern science, outlined above, Gleick's book implies a subversion of the strict binary oppositions between order and disorder, and, as I will discuss later on, global and local. The subversion of the order/disorder distinction arises because Lorenz's simulation mimicked a world which is simultaneously ordered (the 'laws' - equations - which governed it were well known) and disordered (there was an inevitable unpredictability in the system). This disruption is of no small consequence. As Hayles argues, when 'a dichotomy as central to Western thought as order/disorder is destabilised, it is no exaggeration to say that a major fault line has developed in the episteme.'³⁵

This is, perhaps, the central aspect of the change in the status of knowledge in postmodern discourses. Because order and disorder were seen as mutually exclusive states, the order/disorder divide had prioritised one over the other: the option was between accepting absolute chaos (that which could not be understood in any except the most banal terms), or trying to impose order on that chaos (encompassing it within strict, deterministic bounds). With the growing popularity of postmodern discourses of various kinds, it became possible to open up the territory between order and disorder; to see the two states not necessarily as antitheses of one another, but to see chaos as a site with great potential for producing new meanings and new kinds of order. It is this understanding of chaos which is emphasised in Prigogine's book: 'We come to one of our main conclusions: At all levels, be it the level of macroscopic physics, the level of fluctuations, or the microscopic level, *nonequilibrium is the source of order*. *Nonequilibrium brings "order out of chaos."*' But as we already mentioned, the concept of order (or disorder) is more complex than was thought.'³⁶ An equivalent, though slightly different, emphasis is apparent in Gleick's work, where he describes how chaos theorists in various disciplines have found powerful tools to describe phenomena that otherwise appeared to be random.

³⁴Gleick, *Chaos* 23.

³⁵Hayles, *Chaos Bound* 16.

³⁶Prigogine 286-87.

I will now demonstrate the ways in which *Gravity's Rainbow* subverts the order/disorder distinction. Although it makes no reference to chaos theory (it was published two years before James Yorke even coined the term), it imagines a new science which embodies some of the postmodern characteristics of chaos theory.

Mining the First Binary Divide: (ii) From Pointsman to Mexico in *Gravity's Rainbow*

Just as presentations of chaos theory struggle with language to get it to express the new ideas, and eventually solve the problem by effectively redefining *chaos*, so *Gravity's Rainbow* also draws our attention to the limits, and the ideological biases, of our language. This is, in fact, a central theme of the novel. For instance, it suggests that the language used to describe the development of plastics is intricately bound up with the political atmosphere of National Socialist Germany - so, the 'target property most often seemed to be strength - first among Plasticity's virtuous triad of Strength, Stability, Whiteness (*Kraft, Standfestigkeit, Weiße*: how often these were taken for Nazi graffiti [...]).'³⁷

With Ned Pointsman's and Roger Mexico's differing approaches to the problem of explaining why V-2 rockets fall on every part of London in which Slothrop has an erection, what we are presented with is a clash between two languages for knowing the world, as well as two scientific methods. They are set up as complete opposites, a point emphasised by the assertion that if 'ever the Antipointsman existed, Roger Mexico is the man,'³⁸ and that Pointsman is the 'Antimexico.'³⁹ Pointsman represents the older scientific approach, whereas Mexico's science carries the hallmarks of a postmodern discourse.

Pointsman's approach to the problem involves the three principles of modern science which I outlined above, and which I showed Gleick's text to refute: a belief that everything can be known, and that, following from this, prediction and control are possible. Significantly, Pointsman finds a role model in Pavlov, who is specifically associated with the understanding and control of creatures' responses to various stimuli. Pavlov's Book (it is, significantly, capitalised in the text) circulates among Pointsman and six other owners like a mystical text, charged with religious significance. Steven Weisenburger points out that the book had actually appeared in an

³⁷Pynchon, *Gravity's Rainbow* 250. Here, and elsewhere, I use square brackets to distinguish my ellipses from Pynchon's.

³⁸Pynchon, *Gravity's Rainbow* 55.

³⁹Pynchon, *Gravity's Rainbow* 89.

English translation in 1941, and so the secrecy with which it is rotated by Pointsman, Spectro and the others is a 'bit of melodrama' on Pynchon's part.⁴⁰ Actually, Weisenburger may have missed the fact that the book's rarity stems, in *Gravity's Rainbow*, not from the unavailability of a translation, but from air-raid damage to existing stocks ('most existing copies had been destroyed in their warehouse early in the Battle of Britain').⁴¹ The origin of the book's scarcity is, however, a minor point - what is interesting is that Pynchon engineers its destruction in order to give it this rarity value, and so to lend this air of mystery to the science practised by Pointsman, Spectro and the other keepers of the book.

Pointsman sees himself as taking up Pavlov's work where it was left unfinished at his death, and has no doubt that there is an answer to the mystery posed by Slothrop: '[Pavlov] died at the very threshold of putting these things on an experimental basis. But I live. I have the funding, and the time, and the will.'⁴² This self-justification is important because it shows that, for Pointsman, there is nothing which cannot be known given enough time and funding, just as Laplace thought that all was knowable, given enough information.

He is also certain that the truth, when it becomes apparent, will demonstrate the efficacy of a particular scientific world-view, characterised in the text as 'cause-and-effect.' Pointsman follows Pavlov in believing that 'the ideal, the end we all struggle toward in science, is the true mechanical explanation [...] No effect without cause and a clear train of linkages.'⁴³ This, he is certain, will underpin the mystery posed by Slothrop: 'But if it's [the cause is] in the air, right here, right now, then the rockets follow from it, 100% of the time. No exceptions. When we find it, we'll have shown again the stone determinacy of everything, of every soul.'⁴⁴

Pointsman is only one among many representatives of the 'cause-and-effect' view in the novel. His approach to solving the problem of the link between Slothrop and the rocket is based upon the belief that, given enough information, it will be possible to identify a direct chain of links which tie them together. Prediction is tied in with this notion of cause and effect. Franz Pökler, the 'cause-and-effect man'

⁴⁰Steven Weisenburger, *A Gravity's Rainbow Companion: Sources and Contexts for Pynchon's Novel* (Athens: U of Georgia P, 1988) 37. The 'Book' is vol. 2 of Pavlov's *Lectures on Conditioned Reflexes*.

⁴¹Pynchon, *Gravity's Rainbow* 87.

⁴²Pynchon, *Gravity's Rainbow* 90.

⁴³Pynchon, *Gravity's Rainbow* 89.

⁴⁴Pynchon, *Gravity's Rainbow* 86.

according to his wife Leni,⁴⁵ is part of the team who are obsessed with predicting the flight path of the nascent V-2 rockets on which they work. Similarly, the delightfully named Brigadier Pudding, hopes to write a definitive political treatise entitled *Things That Can Happen in European Politics*.

This, in turn, is linked to the doctrine of control. The actual language of the engineers who work on the rocket, reflects this: 'they thought this way, Design Group, in terms of captivity, prohibition.'⁴⁶ Pointsman, also, is obsessed with the need to assert various forms of control, holding ultimate responsibility for sending Slothrop off across the Zone on the trail of the rocket, and trying to keep Mexico under his control by sending Jessica to Cuxhaven, where she cannot distract him from his work. Indeed, from the outset, Pointsman is presented as an ominous figure - our first impression of him is as a smell of ether⁴⁷ - and his urge to control is linked in with sadistic sexual fantasies: 'And how much of the pretty victim straining against her bonds does Ned Pointsman see in each dog that visits his test stands ... and aren't scalpel and probe as decorative, as fine extensions as whip and cane?'⁴⁸ His journal entry on Slothrop - '*We must never lose control*'⁴⁹ - perhaps illustrates his fear of being out of control, and being faced with that which cannot be fully explained by scientific analysis.

Yet this whole doctrine - to know in complete detail, to predict, and to control - is shown to be false in the novel. The information that Pointsman gets about Slothrop is shown to be beset by inaccuracy and uncertainty. For instance, Harvey Speed and Floyd Perdoe are sent on a mission to identify some of the women on the map that Slothrop kept of his affairs in London, but find it impossible to trace them. Although this uncertainty about Slothrop hits Pointsman like 'a gigantic moray eel, its teeth in full imbecile death-smile,'⁵⁰ he tries to couch the uncertainty that it engenders in scientific euphemisms:

'The data, so far are incomplete. This ought to be prominently stressed in all statements. 'We admit that the early data seem to show,' remember, *act sincere*, 'a number of cases where the names on Slothrop's map do not appear to have counterparts in the body of fact

⁴⁵Pynchon, *Gravity's Rainbow* 159.

⁴⁶Pynchon, *Gravity's Rainbow* 518.

⁴⁷Pynchon, *Gravity's Rainbow* 42.

⁴⁸Pynchon, *Gravity's Rainbow* 88.

⁴⁹Pynchon, *Gravity's Rainbow* 144

⁵⁰Pynchon, *Gravity's Rainbow* 272.

we've been able to establish along his time-line here in London.

Establish *so far*, that is.⁵¹

The novel shows the impossibility of getting perfect data about Slothrop. Just as there are these limits on the quantity and quality of information those who attempt to understand Slothrop can get, so there are also limits on the extent to which predictions can be made and control can be wielded by the proponents of cause-and-effect.

Brigadier Pudding's attempt to predict all possible paths down which European politics might travel, is beset from the outset by the impossibility of processing enough data quickly enough to outpace actual events, and he finds himself becoming increasingly uncertain as his predictions are overtaken by the events themselves:

Begin, of course, with England. 'First,' he wrote, 'Bereshith, as it were: Ramsay MacDonald can die.' By the time he went through resulting party alignments and possible permutations of cabinet posts, Ramsay MacDonald had died. 'Never make it,' he found himself muttering at the beginning of each day's work - 'it's changing out from under me. Oh, dodgy - very dodgy.'⁵²

Similarly the perfect rocket, that will land exactly on its target, is never built, although Franz Pöckler, waiting at 'Ground Zero' to observe a test flight (on the basis that no rocket is perfect, so it is safest to wait at the exact point at which it is aimed), finds his fears of being controlled by others feeding a raging paranoia that the perfect rocket will be aimed at him.⁵³

Pointsman, too, is finally unable to control Slothrop. What we have in all these attempts to know, predict and control is the conviction that it is possible to find order within the universe. Yet, the novel's central mystery - the link between Slothrop and the rocket - is never solved, and part of the reason for this is the inadequacy of the disciplines that are brought to bear upon the problem.

However, an alternative mode of knowing is offered. Although the world with which the characters are faced does not turn out to be ordered in the ways they expect, this does not mean it is wholly disordered. Mexico's science differs from Pointsman's in terms of the sort of explanations it seeks for phenomena. This is, perhaps, epitomised by his use of the Poisson equation, which does not tell exactly where the rockets will strike, or indeed offer a cause-and-effect explanation for why they will hit a

⁵¹Pynchon, *Gravity's Rainbow* 272.

⁵²Pynchon, *Gravity's Rainbow* 77.

⁵³Pynchon, *Gravity's Rainbow* 424-26. It is, in fact, reasonable to argue that the novel does imagine the perfect rocket to be built, and that it is this which hangs above the movie theatre at the end of the book - if so, then it is associated with the imposition of a cause-and-effect viewpoint in the face of the novel's expressed desire for a less rigid philosophy.

particular place. Rather, it 'will tell, for a number of total hits arbitrarily chosen, how many squares will get none, how many one, two, three, and so on.'⁵⁴ There is, of course, nothing fundamental to the Poisson equation which links it to chaos theory. It comes from classical mathematics, and illustrates Mexico's commitment to statistics as a way of dealing with random phenomena. However, the twist given to Mexico's science by Pynchon lends it characteristics which we can see coming out, over a decade later, in Gleick's and Prigogine's narratives of chaos theory.

Mexico questions Pointsman's methods, particularly his desire to take everything apart and divide it into its constituent elements in order to get perfect data: 'I wonder if you people aren't a bit too - well, strong, on the virtues of analysis. I mean, once you've taken it all apart, fine, I'll be the first to applaud your industry. But other than a lot of bits and pieces lying about, what have *you* said?'⁵⁵ Mexico seems to operate on a level which is between parts and whole, between global and local, and he certainly practises a style of science which is not concerned with binary oppositions, but sees the world in a more complex way: '[I]n the domain of zero to one, not-something to something, Pointsman can only possess the zero and the one. He cannot, like Mexico, survive anywhere in between. [...] But to Mexico belongs the domain *between* zero and one - the middle Pointsman has excluded from his persuasion - the probabilities.'⁵⁶

Pointsmen can only see things in terms of a binary opposition that works in an either-or relationship, whereas Mexico is concerned with uncovering the ground in between. This reference to the ground in between has its origins in the expression of probabilities in terms of decimal points between zero and one (whereby, zero represents something which will never happen, and one represents something which will always happen). Although this is an aspect of modern science, the twist given to it by Pynchon lends it postmodern characteristics. Mexico is described as seeing things in a way which is fundamentally different to that of Pointsman.

He also resists the notion of direct prediction, for which Pointsman and the other representatives of cause-and-effect strive. Although he can predict the distribution of rocket strikes, he cannot predict which places are more likely to get hit by the rockets. This is because there is not a cause-and-effect link between separate rocket firings, and the likelihood of one area of the city getting hit by the rockets is not in any way altered by previous hits upon that area; as he tells Pointsman, '[e]ach hit is

⁵⁴Pynchon, *Gravity's Rainbow* 55.

⁵⁵Pynchon, *Gravity's Rainbow* 88.

⁵⁶Pynchon, *Gravity's Rainbow* 55.

independent of all the others. Bombs are not dogs. No link. No memory. No conditioning.'⁵⁷

Importantly, Mexico's distance from Pointsman is not presented as just another way of doing science, but as a new methodology which will supersede the cause-and-effect method - an insight which is crucial to my characterisation of Mexico's science as postmodern. Both men perceive the threat which Mexico's approach to phenomena poses to Pointsman's. For instance, Mexico tells Pointsman that 'there's a feeling about that cause-and-effect may have been taken as far as it will go. That for science to carry on at all, it must look for a less narrow, a less . . . sterile set of assumptions. The next breakthrough may come when we have the courage to junk cause-and-effect entirely, and strike off at some other angle.'⁵⁸

It is interesting that Mexico does not see the new science as a continuation of previous scientific enterprises, in the way that Pointsman sees his work as a continuation of that of Pavlov, but as a 'junking' of them. This ties it in with the revolutionary characteristics which are given to chaos theory by Gleick (particularly through his suggestion that it constitutes a Kuhnian revolution), and Prigogine.

Pointsmen also sees Mexico's science as a fundamentally new approach to the world but, unlike Mexico, he finds it tremendously threatening rather than liberating:

How can Mexico play, so at his ease, with these symbols of randomness and fright? Innocent as a child, perhaps unaware - perhaps - that in his play he wrecks the elegant rooms of history, threatens the idea of cause and effect itself. What if Mexico's whole *generation* have turned out like this? Will Postwar be nothing but 'events,' newly created one moment to the next? No links? Is it the end of history?⁵⁹

A number of critical elements in this soliloquy by Pointsman signal that he is giving expression to a gulf, not only between himself and Mexico, but also between the age of the Enlightenment and that of the postmodern. Firstly, he makes an association between a method of rational analysis ('the ideas of cause and effect') and a way of conceiving of the world ('the elegant rooms of history'). Linearity is not only a scientific method; it forms the basis from which history is understood. Secondly, this is under threat from a new way of perceiving history - Mexico 'wrecks' the elegant rooms of history with his 'symbols of randomness and fright' (the equations with which he analyses statistical data). Thirdly, the new methods of perception may well eventually completely overcome the old ones for Mexico's whole 'generation' may turn

⁵⁷Pynchon, *Gravity's Rainbow* 56.

⁵⁸Pynchon, *Gravity's Rainbow* 89.

⁵⁹Pynchon, *Gravity's Rainbow* 56.

out like this, leaving the old beliefs behind with the previous generation. Finally, the new generation is 'Postwar,' and thus the Second World War is identified as the point at which the new paradigm began to assert itself over the old - tying in with Lyotard's contention, referenced earlier, that there was a change in the status of knowledge at about the middle of this century.

So, we get a clear sense of Mexico practising a science which poses a threat to that of Pointsman, and looking forward to a post-war science which will supersede the linear, cause-and-effect methodologies and beliefs of Enlightenment epistemologies. Mexico is shown to be dispensing with simplistic binary oppositions, to renounce the belief in ultimate knowledge and prediction, and to shift away from a paradigm which denotes complete control over nature and people. As I have shown, these characteristics appear, albeit in a slightly different way, in Gleick's and Prigogine's presentations of chaos theory. I will now go on to expand upon my comment that these texts also upset the distinction between global and local.

Mining the Second Binary Divide: Between Paranoia and Anti-paranoia

But as we have seen, the little narrative [*petit récit*] remains the quintessential form of imaginative invention, most particularly in science.⁶⁰

After characterising modernity as the age of grand narratives, or meta narratives, Lyotard offers postmodernity as a renunciation of this emphasis upon all-embracing meaning structures. He claims that the alternative offered by postmodernity is that of the *petit récits*, the 'little narrative' which contests things on a small scale, and has no presumptions to speak for the global picture. In other words he sees an emphasis upon the local replacing that on the global.

I will argue in this section that the alternative to the grand narrative, offered in the postmodern discourses with which I am dealing, is in fact somewhat more radical than that envisioned by Lyotard. This is because they seem to reject both the local and the global. To adopt *petit récit* instead of metanarratives is to maintain the binary opposition between global and local, just emphasising one pole instead of the other. What postmodern discourses do, is contest the basis of this binary distinction between global and local, emphasising the way in which scaling factors connect the two. This is perhaps most obvious in certain presentations of chaos theory, so it is these with which I shall begin.

⁶⁰Lyotard 60.

One of Gleick's emphases, in his description of chaos theory, is on the ways in which it involves reconsidering nature from a point of view which transcends the boundaries between the very small and the very large, seeing them to be linked by a continuum of ever-increasing scale, rather than as being completely separate. This ties in closely with the ways in which he presents chaos as a revolutionary science, because it involves reconceptualising the world, and draws our attention to the biases that are built into our conceptions of it:

How big is it? How long does it last? These are the most basic questions a scientist can ask about a thing. They are so basic to the way people conceptualize the world that it is not easy to see that they imply a certain bias. They suggest that size and duration, qualities that depend on scale, are qualities with meaning, qualities that can help describe an object or classify it.⁶¹

As in his disruption of the chaos/order binary opposition, Gleick here draws our attention to two different languages for knowing the world: the commonsensical terms which we are used to employing, and the insights we can achieve when we interrogate these categories.

Sensitive dependence on initial conditions (the 'butterfly effect') draws our attention to the importance of scaling - tiny differences at a microscopic level have a huge effect on the macroscopic level because these different scales are connected to each other in a continuum; they are not separate phenomena. This comes out in Gleick's discussion of the weather, in which he links hurricanes to smaller atmospheric phenomena:

Hurricane. By definition, it is a storm of a certain size. But the definition is imposed by people on nature. In reality, atmospheric scientists are realizing that tumult in the air forms a continuum, from the gusty swirling of litter on a city street corner to the vast cyclonic systems visible from space. Categories mislead. The ends of the continuum are of a piece with the middle.⁶²

This obviously has profound consequences for ideas of the local and the global. Gleick implies that they cannot be seen as phenomena that are, to all intents and purposes, separate (as the categories implied by the language we use suggest), if we are to understand how complex systems like the weather really work. Another way in which this idea of multiple scales, linked by continual transitions between them, comes out, is in the visual images with which chaos is associated: fractals. Some of these images,

⁶¹Gleick, *Chaos* 107.

⁶²Gleick, *Chaos* 108.

familiar from t-shirts, posters and elsewhere, are reproduced in Gleick's book, and can be said to be some of the most important icons in the canon of chaos.

He introduces us to them in his chapter 'A Geometry of Nature,' which describes the mathematical shapes (the 'fractals') created by Benoit Mandelbrot, as a geometry which departs in a significant way from that initiated by Euclid. Euclidean geometry dealt in idealisations - cones, spheres, and so forth - whereas Mandelbrot's concentration on 'fractional dimension' becomes 'a way of measuring qualities that otherwise have no clear definition: the degree of roughness or brokenness or irregularity in an object.'⁶³ Mandelbrot's most widely known creation was the 'Mandelbrot set' which is one of chaos's most compelling visual icons, and appears on many t-shirts and posters. This is, essentially, a set of instructions to a computer - or, more accurately, an equation which can be explored graphically by a computer. The pattern it produces can be magnified infinitely. As you zoom in you find the same pattern - with slight differences - recurring on every level.

This image - a set of frames from which are reproduced in Gleick's book - illustrates perfectly the disruption of the global/local binary opposition, and how it relates to that of the order/disorder dichotomy. There is no fundamental distinction between global and local because a similar pattern recurs regardless of the magnification at which the set is viewed: the infinity of scales contained within the image is what lends it its potency. Yet, although there is this resemblance between the images at different scales, the relationship between the separate images is neither ordered nor disordered. They are not disordered, because there are visual echoes which can be easily identified, and recurring twists to the shapes show that the images are related - they have definitely not been randomly assembled. However, neither are they ordered in a conventional sense, because the images are not identical - rather they are 'self-similar'; nearly, but not quite, the same. You find the same images almost, but not quite, repeating themselves as you go down through the scales.

Nor do you ever reach a point where you have explored the full complexity of the set, an ultimate particle below which you cannot go, because there are always lower levels to explore. The Mandelbrot set stands, therefore, as a visual metaphor for the insights offered by chaos theory, and its disruption of our traditional understanding of such ideas as order, disorder, global and local. As chaos's most resonant public image it traces the passage from disorder to chaos, and treads a path between global and local.

This relates in some ways to Mexico's approach to the territory 'between the zero and the one,' about which I have already written. His statistical analysis of the rocket strikes on London gives him access to an understanding which Pointsman is

⁶³Gleick, *Chaos* 98.

denied by his strict concentration on the either/or dichotomy between one and zero. It is also rather similar to the sense we get at the end of *The Crying of Lot 49*, where Oedipa Maas is finally exiled into an excluded middle, 'walking among matrices of a great digital computer, the zeroes and ones twinned above. . .'.⁶⁴

However, the key notions which illustrate an interest in that which lies between the global and local in *Gravity's Rainbow*, come in Pynchon's treatment of the ideas of paranoia and anti-paranoia, the first of which represents a globalising impulse, and the second of which denotes a localising drive. Both of these ideas are shown to be untenable in *Gravity's Rainbow*, in relation to both the character of Slothrop, and the interpretative strategies by which the reader makes sense of the novel.

Paranoia is defined in the text as the discovery that '*everything is connected*, everything in the Creation [....]'.⁶⁵ For Slothrop this amounts to the realisation that he is being controlled by outside forces, and that there is a mysterious connection between himself and the rocket, over which he has no control. This is an impossible situation in which to live because, without exception, everything becomes connected in a web that manipulates him. Paranoia implies a globalising impulse to Slothrop's understanding of the world, because everything must be connected in a coherent conspiracy against him.

Yet anti-paranoia is equally untenable because it implies the complete opposite to paranoia, in which 'nothing is connected to anything, a condition not many of us can bear for long'.⁶⁶ Towards the end of the novel Slothrop finds himself experiencing this, 'sliding onto the anti-paranoid part of his cycle',⁶⁷ and feeling that he does not belong anywhere in the world, and that there are no meaningful connections between different things. At least paranoia suggested that 'They have put him here for a reason'; the alternative is even more disturbing because it suggests that 'he's just here'.⁶⁸ In other words only the local (he himself) has any relevance to him, and he does not fit into the larger, global scale of things.

Slothrop's eventual disintegration may illustrate the inadequacy of these sharp choices between paranoia and anti-paranoia, global and local, with which he is faced. For much of the novel his paranoia leads him to try to understand how he fits into the schemes of others. Yet it is impossible to fully comprehend this because the multitude

⁶⁴Thomas Pynchon, *Crying* 125.

⁶⁵Pynchon, *Gravity's Rainbow* 703.

⁶⁶Pynchon, *Gravity's Rainbow* 434.

⁶⁷Pynchon, *Gravity's Rainbow* 434.

⁶⁸Pynchon, *Gravity's Rainbow* 434.

of forces that serve to condition him do not slot together into one giant, coherent and totally-unified scheme. As a result he finds himself playing a number of mutually-exclusive roles (Plechazunga, the pig hero; Ian Scuffling, the war correspondent; and Rocketman, the comic-book hero, for instance). In other words it actually throws him into a kind of anti-paranoia, a schizophrenia in which he keeps flitting from one role to another, unable to connect between them, as he occupies the central position in different people's conceptions of him. Even when he seems to realise that he is losing track of himself, his attempt to recover his identity and hold onto a unified conception of himself, becomes just another way of slotting himself into someone else's story, in this case the rigid structure of a private-detective film: 'Yeah! yeah what happened to Imipolex G, all that Jamf a-and that S-Gerät, s'posed to be a hardboiled private eye here, gonna go out all alone and beat the odds, avenge my friend that They killed, get my ID back and find that piece of mystery hardware.'⁶⁹

The constant changes of costume through which Slothrop goes in the course of the novel illustrate these shifting identities. Earlier on in the book, when he counter-conspires most successfully against 'Them,' he chooses his own wardrobe, dressing, for instance, in garish clothes at Raoul's party: 'green French suit of wicked cut with a subtle purple check in it, broad flowered tie [...] brown and white wingtip shoes with golf cleats, and white socks.'⁷⁰ Yet most of the time his costumes - the pig-suit, the Rocketman regalia, and so forth - are chosen for him. Similarly, Slothrop's lack of control over himself, and the way in which he is forced to fit himself into a number of mutually-exclusive paranoid schemes, are expressed through the lack of control he wields over his own voice. I noted that he adopts the voice of the private detective in trying to understand what he is doing in the Zone, towards the end of the novel. Similarly, he finds himself unwillingly adopting what can only be described as a John-Wayne drawl, when he confronts Morituri, the Japanese Ensign, who has been watching him make love with Bianca: "'Yeah, I . . ." why is Slothrop drawling this way? "saw ya watching . . . last *night too*, mister. [...] W'l hell, Ensign . . . why don'tcha just . . . join in? *They're* always lookin' fer . . . company."⁷¹

Facing the world only with paranoia, as he impossibly tries to make everything fit into a single scheme, devoted to him; or the alternative, anti-paranoia, where he has no connection with anything else; Slothrop's attempts to make sense of his world are doomed to failure. Once the paranoid approach fails, he is sent to the opposite, anti-paranoid pole, and it is perhaps this that we can use to explain Slothrop's eventual

⁶⁹Pynchon, *Gravity's Rainbow* 561.

⁷⁰Pynchon, *Gravity's Rainbow* 244.

⁷¹Pynchon, *Gravity's Rainbow* 473.

disintegration at the end of the novel when he is '[s]cattered all over the Zone.'⁷² What the novel seems to suggest is the need for a middle ground, between global (paranoia) and local (anti-paranoia).

This can be seen, not only in relation to Slothrop's attempt to make sense of his world, but also in relation to the reader's attempt to make sense of *Gravity's Rainbow*. Much has been made of the way in which the novel repudiates closure and resists the imposition of ordered meaning structures upon it. Lance Olsen, for instance, argues that 'the text abandons the Newtonian belief in cause-and-effect and drifts into a world of statistical probability,'⁷³ and Robert D. Newman claims that 'the implication inherent [in the novel's refusal to coalesce into meaning structures] is that interpretation as a stay against confusion fosters entropic and delusory patterns in its effort to harness the flux of life.'⁷⁴ Both critics imply that the novel resists attempts to produce comprehensive interpretations of it, and that it will not yield to any overall explanation - for Olsen, any form of cause-and-effect is rendered implausible by the novel, and for Newman any interpretation that we produce is delusion, because it will not render the full reality of life. In other words, they imply that we must abandon a 'paranoid' criticism, which aims to make everything about the text yield up its meaning and fit into a grand interpretative structure.

This repudiation of what I have dubbed paranoid criticism is fully justified, but Olsen and Newman seem to assume that by rejecting it, and by rejecting the text's closure, we necessarily have to go to the opposite extreme, and adopt an anti-paranoid approach which refuses to find any meaning in the text at all. If we reject any sort of cause-and-effect, and any sort of interpretation, then the novel just fragments, much as Slothrop himself does, into a renunciation of all meaning. This is, of course, as untenable for literary criticism, as it is unpleasant for Slothrop. If we read, and especially if we write about, the novel, we necessarily find some meaning in it, and this is of course exactly what Olsen and Newman do in the remainder of their articles.

Gravity's Rainbow is not so much a rejection of all possibility of meaning, as of traditional meaning structures. Paranoia (connection and control) and anti-paranoia (complete lack of connection and control), are part of the same Enlightenment discourse which stresses that we must adopt one or the other of these. Pynchon's novel suggests that they need not be antagonistically opposed to each other, and fosters the production of interpretations which are never stable. By necessity we create meanings from the

⁷²Pynchon, *Gravity's Rainbow* 712.

⁷³Lance Olsen, 'Deconstructing the Enemy of Color: The Fantastic in *Gravity's Rainbow*,' *Studies in the Novel* 18 (1986), 80.

⁷⁴Robert D. Newman, *Understanding Thomas Pynchon*, Understanding Contemporary American Literature (Columbia: South Carolina UP, 1986) 132.

novel as we read it, but these meanings are always in flux, always exploring the scales between paranoia (where the text yields a single unitary meaning) and anti-paranoia (where the text dissolves into a series of disconnected episodes).

To return, at last, to the brief discussion about Lyotard with which I began this sub-section, what both Slothrop and the reader find is the inadequacy of trying to construct either grand narratives, or just *petit récit*, to make sense of the world. When Slothrop is beset by paranoia, and sees himself as the product of a universal conspiracy, he is trying to construct a grand narrative which will make sense of everything. Similarly, when the reader tries to make the huge volume of information which constitutes *Gravity's Rainbow*, cohere into a lucid, unitary meaning, he or she is also trying to construct a grand narrative that will make sense of everything within the text. Both are doomed to failure because there is too much information, and because there is a surfeit of plausible, but contradictory, explanations which make sense of it.

Conversely, when Slothrop is beset by anti-paranoia, he ceases trying to connect with the rest of the world, and in effect constructs a *petit récit* which is over-zealous in its embrace of the local (there is just him, and there is no link to the rest of the world). If the reader, despairing at the impossibility of making ultimate sense of the novel does the same, and tries to disconnect the different pieces of information from each other, then he or she is in effect resolving the novel into a series of *petit récit*. This must fail as surely as a grand narrative will. Slothrop does fit into the wider scheme of things in some respects, and cannot exist on his own. Nor can the reader ever, for more than a moment, seriously entertain the notion that the novel is beyond interpretation - it is just that our interpretations stay in flux.

A grand narrative implies a rigid structure into which everything must fit, and a *petit récit* implies no large structure at all. Neither option is supported by presentations of chaos theory, or postmodern literature, and it is this elementary rejection of rigid notions of global and local, and order and disorder, which lies at the root of many connections between contemporary discourses of science and literature.

CHAPTER 6 - DISCOURSES OF IDENTITY

We live not in an information age but a cybernetic one. Our lives are dominated not only by the getting and sending of information, but the spin-offs from this technology.¹

David Porush's *The Soft Machine*, quoted here, traces the genesis of a particular branch of postmodern fiction which he terms *cybernetic*. The essence of his argument is that fiction has always dealt with the various metaphors of machines which are used to characterise humans. In recent years the predominant machine metaphor has changed as our machines have changed. Now information-processing machines, particularly computers, dominate our culture and so fiction has also changed to reflect and contest these new metaphors.

This chapter is conceived in the spirit of Porush's study, in that it explores the disputed border between the natural and the artificial. Just as the last chapter showed how postmodern discourses of knowledge upset binary distinctions between order and disorder, and global and local, so this chapter will investigate the opening up of a territory between the natural and the artificial in postmodern discourses of identity. However, it departs from Porush's project by focusing directly on scientific texts at the same level as literary texts. Porush was concerned with a literary cybernetic discourse; I am concerned with literary and scientific cybernetic discourses of identity.

Cybernetic fiction may deal directly with robots or computers, or explore the mechanisation of the human on a deeper, metaphorical level.² Given this, William Gibson's trilogy of novels, *Neuromancer*, *Count Zero*, and *Mona Lisa Overdrive*, are obvious choices for a study hoping to explore cybernetic fiction. Gibson himself is a key figure in the development of 'cyberpunk' science fiction, and the novels' concern with a mechanised future, and with the interrelations of the human and the machine, clearly lend themselves to a study of this type. Whether they mirror their cybernetic themes self-reflexively, in form and style, as they strictly should in order to qualify as cybernetic fictions,³ is more questionable. Nevertheless, there is a conscious concern with the borders between the human and the machine which is, in many ways, representative of a wider cultural concern with the natural and the artificial.

Richard Dawkins' books about evolution are a much less obvious choice for a study of this type. At first his impatience with any form of relativism, his commitment

¹David Porush, *The Soft Machine: Cybernetic Fiction* (New York: Methuen, 1985) 1.

²See Porush, *Soft Machine* 17.

³See Porush, *Soft Machine* 17.

to scientific truth, and his proud assertion of the explanatory powers of a reductionist science, seem to place him outside the bounds of the postmodern literature/science discourse I identified in the first half of this thesis. Stephen Jay Gould, another scientific populariser of evolution, seems a much more natural choice for those seeking confirmation that something akin to postmodernism has found expression in the sciences.⁴

However, my intention is not to read (or misread) Dawkins as a closet postmodernist and relativist. He argues passionately and convincingly for the truth of a particular view of evolution, perhaps best summed up in the title of his book *The Selfish Gene*. Indeed, he argues that the Darwinism he describes is, in its broad outlines, indisputable and accepted by all researchers in the field. For a literary study to comment on this would be to engage in a debate for which the author does not have the expertise to contribute anything useful (and can only express the conviction that, given the explanatory power of the theory of evolution, the evidence available to non-experts, the arguments of experts, and the dangers posed by the creationist alternative, we certainly ought to take it as a given). What I am interested in is the metaphor - of DNA as a digital information technology - which runs through Dawkins' books, *The Selfish Gene*, *The Blind Watchmaker*, *River Out of Eden*, and *Climbing Mount Improbable*.

What a literary study can cast light on is the congruence between this metaphor and those which appear in Gibson's novels, and the ways in which these illustrate the existence of a contemporary discourse of identity which works the fault lines of the natural/artificial divide. In this sense there is a postmodern feel to both Gibson's novels and Dawkins' popular scientific texts. Although they are not as characteristically postmodern as Pynchon's *Gravity's Rainbow* or Gleick's *Chaos*, they nevertheless contain important off-shoots of the postmodern discourse.

Worlds of Information

It is important to begin by stressing the centrality of information, especially as it relates to information technology, to the radically different projects of Gibson and Dawkins. It is vital in two ways, which I shall describe in detail in the course of this section: as a central aspect of the worlds described by the two writers; and, more

⁴Gould seems an obvious choice for two reasons. Firstly because of his interest, as a historian of science, in the shaping influences of contemporary world views on scientific enterprises. Secondly because of his fame as a proponent of 'punctuated equilibrium,' which stresses contingency and chance in the paths taken by evolution, and allies quite naturally with a 'non-determinist' postmodern outlook. In contrast, Dawkins disputes the revolutionary status accorded to punctuated equilibrium in 'Puncturing Punctuationism,' chapter nine of *The Blind Watchmaker* (Harlow: Longman, 1986) 223-52. As I explain however, it is not my intention to argue that Dawkins is himself a 'postmodern scientist' (which is, in any case, a rather meaningless term); rather, that one of his central metaphors is also key to postmodern discourses.

directly, in terms of the information technology which appears in their texts.

Information lies at the heart of the fictional world described by Gibson, because the economy and the lives of the protagonists are driven by exchanges of information; in Dawkins' work, it is important because it is at the centre of the natural world, where the informational content of DNA changes as evolution progresses and one generation succeeds another. Information technology appears in Gibson's novels as an imagined future technology, where current trends towards faster and faster processing of information, and greater interconnectedness of different computer facilities, have been exaggerated to the point where they dominate the cultural and economic worlds; in Dawkins' work it appears as an important metaphor to describe DNA and the creatures and plants which carry it. This emphasis upon these technologies serves to stress and heighten the informational aspect of the worlds the two writers describe. I will begin by exploring these informational characteristics, before going on to deal with the technology associated with them in more detail.

Gibson's stress upon the importance of information is apparent within all three novels, most particularly in his descriptions of 'cyberspace' or the 'matrix.' This is his key invention: a world which resides wholly within computer systems and which is constituted by an unimaginable complexity of data. Case, the central protagonist in *Neuromancer*, watches a child's introduction to cyberspace where it is described as,

A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding . . .⁵

Although it is a 'hallucination,' this world constructed wholly of data is actually the fundamental reality posited in the novels. This is partly because it is not wholly disconnected from the physical world, with the matrix representing data concentrations that exist in economic centres, and therefore producing a contorted correlation between the largest and brightest structures in the matrix, and the busiest cities. It is also because much of the action takes places within the matrix. Case is a 'console jockey,' a 'cyberspace cowboy' who is hired for his skill in navigating the matrix and penetrating restricted areas of it. Importantly, there is a direct feedback from the virtual world to the real world - get caught by defence systems in the matrix and the operator can die, a fate which nearly befalls Bobby Newmark, an aspiring cyberspace cowboy and the eponymous hero of *Count Zero*.⁶

⁵William Gibson, *Neuromancer* (1984; London: Grafton-HarperCollins, 1986) 67. Gibson's ellipses.

⁶William Gibson, *Count Zero* (1986; London: Voyager-HarperCollins, 1995) 31.

However, information, and the technology associated with it, are not just important in providing the scene where the action takes place. It is much more than a mere high-tech, science-fiction backdrop because it is intrinsic to the motivations of Gibson's characters and the world in which they move. Examples which illustrate this centrality of information abound.

For instance, although Gibson only gives us a sketchy background to the short period of history between our own time and that he imagines, we learn that a significant feature of conflicts in this period is the battle for information. So, the three-week war with Russia that we learn about in *Neuromancer* (the novel was written before the end of the cold war) included a battle for and about information for the first time, with American combatants trying 'to burn this Russian nexus with virus programs.'⁷ This operation is the forerunner of the culture Gibson invents where the protagonists are characters like Case and Bobby Newmark, who make their livings trying to break into protected sites and steal information on the matrix.

Similarly, the plot of *Count Zero* revolves around the attempts by one company, Hosaka, to ensure the successful defection of Mitchell, a highly-skilled expert from another company, Maas Biolabs. What they are fighting for here is expertise, the ability to manipulate information. Gibson takes the thriller genre, and blends it with a high-tech world. The future he imagines is one dominated by multinational companies, rather than nation-states, and they have at their disposal immense resources. Indeed, they have acquired all the characteristics of (usually despotic) nation-states, except for the ties to a specific physical territory. Instead of competing for land, they fight for, and deal in, information and technology.⁸

In *Mona Lisa Overdrive*, Britain is described as lagging behind in this shift from the nation-state to the multinational corporation. However, this state of affairs is threatened by Roger Swain, who 'has recently come into possession of a very high-grade source of intelligence and is busy converting it into power.'⁹ By the end of the novel we are to believe that Swain is deploying this information so that he can take over power in the country: 'Now this new business of Swain's, it's liable to bugger things for anyone who isn't right there and part of it. Christ, we've still got a *government* here. Not run by big companies. Well, not directly [...] He's bloody *changing* [the

⁷ Gibson, *Neuromancer* 39.

⁸This mirrors Lyotard's prediction that information will be the most valuable commodity in the future, possibly even replacing land as the key issue over which wars will be fought: 'It is conceivable that the nation-states will one day fight for control of information, just as they battled in the past for control over territory. . . . ' Lyotard 5.

⁹William Gibson, *Mona Lisa Overdrive* (1988; London: Voyager-HarperCollins, 1995) 207.

government]. Redistributing power to suit himself. Information. Power. Hard data.'¹⁰ Because information is so central to the fictional world that Gibson imagines, Swain is able to deploy it as a means of securing political control.

Information also figures prominently in Dawkins' work. Importantly, for my argument, he concentrates upon information as it relates to information technology, presenting the DNA molecule as a sophisticated 'natural' information technology. The centrality of this metaphor to Dawkins' work (at times, because the informational content of DNA seems so intrinsic, this becomes more than metaphorical, as we shall see) derives from his view of evolution from the gene's point of view. The unit of natural selection which is most important, according to Dawkins, is not the species, or even the individual, but the gene - so 'survival of the fittest' means, in effect, survival of the fittest gene. The arguments for taking this view of evolution are highly complex, but it is worth considering one or two aspects of them, in order to see the importance of a certain conception of information to Dawkins' explanations of evolution.

Genes are important in natural selection because the quality of the bodies they build affects their own chances of survival: 'The evolutionary importance of the fact that genes control embryonic development is this: it means that genes are at least partly responsible for their own survival in the future, because their survival depends on the efficiency of the bodies in which they live and which they helped to build.'¹¹ Building on this, Dawkins does not see DNA as the means by which species or individual organisms are preserved into the future, but reverses this popular perception and describes individual organisms as 'survival machines'¹² for genes. Genes which cooperate successfully with each other to build bodies with a greater likelihood of surviving and reproducing than their rivals, will be those which tend to survive into the future. Consequently, 'the basic unit of natural selection is best regarded not as the species, nor as the population, nor even as the individual, but as some small unit of genetic material which it is convenient to label the gene.'¹³

¹⁰Gibson, *Mona Lisa* 268. As with my references to Pynchon's *Gravity's Rainbow*, my ellipses always appear in square brackets to distinguish them from Gibson's when I discuss his work.

¹¹Richard Dawkins, *The Selfish Gene*, 2nd ed. (1976; Oxford: Oxford UP, 1989) 23-24.

¹²This phrase recurs frequently in Dawkins' work - its first appearance is in the fourth line of the preface to his first book. Dawkins, *Selfish Gene* v.

¹³Dawkins, *Selfish Gene* 39. Stephen Jay Gould articulates the argument against Dawkins' selfish gene theory in 'Caring Groups and Selfish Genes,' *The Panda's Thumb: More Reflections in Natural History* (New York: Norton, 1980) 85-92.

Although the further arguments for adopting this gene-centred view of evolution are central to Dawkins' books,¹⁴ they are a distraction from our current task of exploring why the concept of information is so important for appreciating his work. In order to complete this more central task, it is necessary to explain that Dawkins describes DNA as being characterised by its informational qualities.

This comes out in the following sentence: 'DNA can be regarded as a set of instructions for how to make a body, written in the A,T, C, G alphabet of the nucleotides.'¹⁵ The consequence of this is that each individual DNA molecule is less important than the information that it, and every other copy of that molecule, encodes. Obviously, on a local level, it is the individual copy of DNA which contributes to the development of a protein, but it is all the copies of various genes and the bodies which they help to build which, in the long run, have an effect on natural selection and hence evolution. What Dawkins seems to be emphasising then, is that the most useful definition of a gene is a particular sequence of the A,T,C,G alphabet (which has an effect on building a particular aspect of an organism, and hence on evolution), regardless of the individual DNA strands in which it exists. This definition emphasises information over everything else, because each gene is the code which happens to occur on an individual piece of chromosome. It is this informational quality which makes metaphors taken from information technology such potent ways of explaining how DNA works.

With information centred so prominently in the works of Gibson and Dawkins, it is not surprising that information technology, so ubiquitous in the late twentieth century, should itself figure prominently in their books, and it is to this that I will now turn my attention. The centrality of this technology is self-evident in the case of Gibson, and will have been obvious from my earlier comments. What is worth mentioning in addition to these is that genetics itself also figures in his work. Indeed, it is highly significant that the two strands of science and technology which he extrapolates from their present status, to an imagined future level of sophistication, are information technology and genetics. Just as the data coded into computers is open to manipulation and reorganisation, so DNA is projected, in his novels, as being susceptible to recoding.

For instance, we are told in *Neuromancer* that although horses have been extinct for a few years, some people are still trying to 'code 'em up from the DNA,'¹⁶ albeit

¹⁴Arguments favouring the gene-centred view occur in all of Dawkins' books, but can perhaps be found most clearly explained in the third chapter, 'Immortal Coils,' of *The Selfish Gene*. Dawkins, *Selfish Gene* 21-45.

¹⁵Dawkins, *Selfish Gene* 22.

¹⁶Gibson, *Neuromancer* 113.

unsuccessfully, and that mink DNA is used to artificially manufacture fur.¹⁷ Similarly, the novels feature characters who have had their bodies reshaped and remoulded in various ways, and who are adorned with prosthetics of various kinds (most obviously Molly, who features in the first and third books and has, among other attachments, steel blades which emerge from beneath her fingernails). Not only this, but the biological and the electronic are actually merged in various ways. I will discuss this later on in the chapter because it is crucial to the view of identity which the novel offers us.

I have already mentioned how information technology is used in Dawkins' work as a metaphor for understanding genetics and evolution. Three of his best-known books have chapters devoted predominantly to DNA as an information technology: 'The Gene Machine' in *The Selfish Gene*, 'The Power and the Archives' in *The Blind Watchmaker*, and 'The Robot Repeater' in *Climbing Mount Improbable*. In truth, however, the metaphor is not limited to these chapters, and runs right through all four works with which I am concerned here.

Because DNA is defined, in the books, in terms of the information it encodes, it is important to consider what kind of information technology Dawkins is talking about. He frequently emphasises that DNA has the characteristics of a digital, rather than an analogue, information technology: 'The information technology of the genes is digital.'¹⁸ The differences between these two possible sorts of information technology are described at various points by Dawkins - perhaps at greatest length in a four-page section of *River Out of Eden*¹⁹ - but the key characteristics of a digital technology can be briefly summarised. Most importantly, it stores information in a number of discrete states: 'That is the diagnostic feature of a digital system: its fundamental elements are either definitely in one state or definitely in another state, with no half measures and no intermediates or compromises.'²⁰

This has important consequences, most notably the possibility it offers for perfect, or very near perfect, transmission of information - because information is stored in discrete states, it does not deteriorate as it is transmitted from copy to copy. Dawkins demonstrates this in the first chapter of *River Out of Eden* (called significantly 'The Digital River'), by explaining how a digital telephone works:

¹⁷Gibson, *Neuromancer* 149.

¹⁸Dawkins, *Blind Watchmaker* 112.

¹⁹Richard Dawkins, *River Out of Eden*, Science Masters (London: Weidenfield and Nicholson, 1995) 12-16.

²⁰Dawkins, *Blind Watchmaker* 112.

In a digital telephone, only two possible voltages - or some other discrete number of possible voltages, such as 8 or 256 - pass down the wire. The information lies not in the voltages themselves but in the patterning of the discrete levels. . . . The actual voltage at any one time will seldom be exactly equal to any of the eight, say, nominal values, but the receiving apparatus will round it off to the nearest of the designated voltages, so that what emerges at the other end of the line is well-nigh perfect even if the transmission along the line is poor.²¹

It is precisely by this principle that DNA and RNA code genetic information:

the information technology of living cells uses four states, which we may conventionally represent as A, T, C and G. There is very little difference, in principle, between a two-state binary information technology like ours, and a four-state information technology like that of the living cell.²²

It is because of this that Dawkins uses so many analogies from information technology - particularly from computing, which is the digital information technology *par excellence* - in order to describe how genetic information changes and evolves in the course of evolution.

As well as offering the possibility of high-fidelity transmission of information, a digital information storage system also makes natural selection possible. When genes are mixed in reproduction each bit of genetic information comes either from one parent or from the other - it is not a mix of the two. This is important to natural selection because it means that populations do not grow more and more like each other, but diversity is maintained as beneficial traits can be preserved, without dilution, down the generations.²³

So, digital information technology provides a convenient way of understanding how genes work. Indeed, Dawkins goes further and suggests that this is more than a convenient metaphor - information is so central to the business of DNA that it actually is, to all intents and purposes, an information technology. This is most apparent at the beginning of chapter 5, 'The Power and the Archives,' in *The Blind Watchmaker*:

It is raining DNA outside. On the bank of the Oxford canal at the bottom of my garden is a large willow tree, and it is pumping downy seeds into the air. . . . Those fluffy specks are, literally, spreading

²¹Dawkins, *River* 13.

²²Dawkins, *Blind Watchmaker* 115.

²³For a lengthier description of the importance of digitalness to the theory of evolution see Dawkins, *Blind Watchmaker* 113-14.

instructions for making themselves. They are there because their ancestors succeeded in doing the same. It is raining instructions out there; it's raining programs; it's raining tree-growing, fluff-spreading algorithms. That is not a metaphor, it is the plain truth. It couldn't be any plainer if it were raining floppy discs.²⁴

DNA exists, in this view, as a series of instructions for building organisms, and also as a computer program for directing their behaviour: 'genes too control the behaviour of their survival machines, not directly with their fingers on puppet strings, but indirectly like the computer programmer. All they can do is set it up beforehand; then the survival machine is on its own, and the genes can only sit passively inside.'²⁵

The further development of these analogies between genetics and information technology takes us into the whole issue of identity with which the rest of the chapter will be concerned. A quotation from another passage, this time from the beginning of chapter six, 'Genesmanship,' of *The Selfish Gene*, will allow me to summarise what I have said so far about Dawkins:

What is the selfish gene? It is not just one single physical bit of DNA. Just as in the primeval soup, it is *all replicas* of a particular bit of DNA, distributed throughout the world. If we allow ourselves the licence of talking about genes as if they had conscious aims . . . what is a single selfish gene trying to do? It is trying to get more numerous in the gene pool. Basically it does this by helping to program the bodies in which it finds itself to survive and reproduce.²⁶

To define a gene accurately we need to concentrate not so much on one manifestation of it, but the information that it encodes - hence, a particular gene is 'all replicas' of a certain slice of DNA. Information is pushed to the forefront here. The gene has an effect on evolution by 'trying to get more numerous.' In other words, those bits of DNA which are successful at passing on copies of themselves - by influencing their own fate in some way - will be those which will become more numerous and survive into the future. They 'try' to do this by 'programming' the bodies in which they are lodged.

It is here, where analogies with information technology are brought to bear upon the development of various organisms, that we find a discourse of information that taps the same streams as those which Gibson draws on. As I shall show, what both do is call into question the natural/artificial divide, transgressing the border

²⁴Dawkins, *Blind Watchmaker* 111.

²⁵Dawkins, *Selfish Gene* 52.

²⁶Dawkins, *Selfish Gene* 88.

between the two from both directions: there is a migration of things normally associated with the natural into machine territory, and vice-versa. I will begin my study of these border disputes by considering the latter of these transgressions, exploring the ways in which living things are described as, or supplemented by, artificial entities.

Border Disputes along the Natural/Artificial Divide: (i) Electronic Organisms

I have already mentioned that in Gibson's trilogy, physical changes are brought about by the various prosthetics with which characters supplement their bodies. The restrictions of the flesh can also be overcome by accessing cyberspace, with the body transcended, rather than supplemented, in a world where those with the requisite skills manipulate matter-less streams of information.

The characters themselves are referred to, by Gibson and by each other, in technological terms (particularly those to do with information technology and electronic circuitry), and this is another means by which the natural is modified by the electronic. For instance, a drug that Case takes 'lit his circuits,'²⁷ Molly, in resignation, says that she sometimes hurts people because 'I guess it's just the way I'm wired,'²⁸ and she tells Case that she knows 'how you're wired.'²⁹ This ties in with a more general preponderance of technological metaphors used to describe natural phenomena. The most dramatic and well-known of these is the opening sentence of *Neuromancer*: 'The sky above the port was the color of television, tuned to a dead channel.'³⁰ As we begin reading the trilogy, we are immediately faced with a technological description of a natural phenomenon, made all the more poignant as we normally expect the sky to be associated with metaphors of freedom and escape. Indeed, there is an interesting twist upon the convention of pathetic fallacy here - as readers we are just about to meet Case who has had his nervous system damaged by his former employers so that he can no longer have access to cyberspace. He had 'lived for the bodiless exultation of cyberspace' and this is the 'Fall' for him.³¹ He feels imprisoned, 'tuned to a dead channel' like the sky above him.

²⁷Gibson, *Neuromancer* 29.

²⁸Gibson, *Neuromancer* 37.

²⁹Gibson, *Neuromancer* 41.

³⁰Gibson, *Neuromancer* 9.

³¹Gibson, *Neuromancer* 12.

For Case, the character with whom the reader is asked to identify in the first book, the 'natural' body is restrictive. In comparison with the 'bodiless exultation' of cyberspace, the body itself becomes a hindrance: 'In the bars he'd frequented as a cowboy hotshot, the elite stance involved a certain relaxed contempt for the flesh. The body was meat. Case fell into the prison of his own flesh.'³² Indeed, Case is characterised by his contempt for the flesh - 'Travel was a meat thing'³³ we are told, and when death threatens he mutters, '[h]ere comes the meat.'³⁴ Life without technological enhancement of some sort, is unbearable for Case.

All these literal and metaphorical modifications of people by technology, create an atmosphere in which the distinction between nature and artifice is of diminished importance. Perhaps the most important way in which these incursions from the artificial into the natural are made is through the 'constructs,' which can be found in the form of Dixie Flatline, in the first book, and Finn, in the third. These allow Gibson to open up questions about what makes things alive, and what distinguishes the organic from the inorganic.

The constructs are coded, computer versions of dead people, 'a hardwired ROM cassette replicating a dead man's skills, obsessions, knee-jerk responses.'³⁵ This definition provides an interesting comparison to a passage in *The Blind Watchmaker*, where Dawkins seeks to explain genetic information as a certain kind of computer memory: 'DNA is ROM. It can be read millions of times over, but only written to once - when it is first assembled at the birth of the cell in which it resides. The DNA in the cells of any individual is "burned in". . . .'³⁶ These quotations from Gibson and Dawkins illustrate why the pairing of genetics and information technology is so seductive - information technology provides the metaphor by which we know genetics, because it fits so neatly into our need to understand how information, encoded in DNA, can affect our bodies.

The pairing of the two raises questions about definitions of life and death, sentience and pure mechanical insentience. These questions are generally implicit in Gibson's novels, but become explicit in a number of passages relating to the constructs and to the Artificial Intelligences (AIs), which I shall return to in more detail later. Case asks Dixie Flatline whether or not he is sentient: "'Well it *feels* like I am, kid, but I'm

³²Gibson, *Neuromancer* 12.

³³Gibson, *Neuromancer* 97.

³⁴Gibson, *Neuromancer* 194.

³⁵Gibson, *Neuromancer* 97.

³⁶Dawkins, *Blind Watchmaker* 117.

really just a bunch of ROM. It's one of them, ah, philosophical questions, I guess . . .” The ugly laughter sensation rattled down Case's spine. “But I ain't likely to write you no poem, if you follow me. Your AI, it just might. But it ain't no way *human*.”³⁷ Even Dixie does not know if he is sentient or not - and even were he to claim that he was, it would raise the question of whether he (it?) had just been programmed to behave in a life-like way, to the extent of claiming to be alive.

Kumiko, in *Mona Lisa Overdrive*, is similarly curious about the Finn, a character from the first and second novels, who is now dead but has had his personality coded into a computer in an armoured housing:

The thing in the armored housing, she reasoned, was of a similar nature [to personality-recordings of dead company directors in her father's company], though perhaps more complex [...] Finn, Sally called it, and it was evident that this Finn had been a friend or associate of hers.

But did it wake, Kumiko wondered, when the alley was empty?

Did its laser vision scan the silent fall of midnight snow?³⁸

There is a sense in which both these constructs are just reconstructions, imitations of dead people. Yet, they seem so convincing in their imitation of life that they are treated as though they are alive, and may perhaps be so. The question these episodes raise is about the level of complexity at which something ceases to be a clever imitation and becomes, to all intents and purposes, alive - at what point do these constructs pass across the border from the artificial to the sentient? Does the Finn only exist as a living thing for other people, or is it alive for itself, when it is alone and scans the ‘midnight snow’?

Dawkins' work also includes numerous examples of the incorporation of machines and technology into what we are used to thinking of as being naturally alive. Although the incorporation is in many of these cases metaphorical - things are described as machines in order to explain how they work - the issues that are raised (about determinism and the borders between the natural and the artificial) are remarkably similar to those broached by Gibson.

Most obvious is his description of organisms as ‘survival machines’ for genes. As mentioned earlier, he reverses the commonly held assumption that genes are the means by which organisms ensure the continuation of the species into the future, and pictures the body as a machine built by genes in order to guarantee their survival down the ages. This is most dramatically stated in the paragraph that ends the second chapter of *The Selfish Gene*. After describing one theory of the initial evolution of life on earth

³⁷Gibson, *Neuromancer* 159.

³⁸ Gibson, *Mona Lisa* 174.

(whereby an initial chance event leads to the existence of replicators, molecules capable of copying themselves, which gradually improve as the best ones survive at the expense of the others) he asks what has happened to the replicators now, answering this question with the following statement:

Now they swarm in huge colonies, safe inside gigantic lumbering robots, sealed off from the outside world, communicating with it by tortuous indirect routes, manipulating it by remote control. They are in you and in me; they created us, body and mind; and their preservation is the ultimate rationale for our existence. They have come a long way, those replicators. Now they go by the name of genes, and we are their survival machines.³⁹

The analogy with robots is in some respects a metaphor. However, there is also a truth to it which works the natural/artificial divide. This is brought out in a fascinating endnote which appears in the second edition of the book. Here, Dawkins tells us that the passage I have just quoted has been cited 'in gleeful evidence of my rabid "genetic determinism"'.⁴⁰

The problem with this objection, Dawkins claims, is that it makes the outdated assumption that robots are 'rigidly inflexible morons'.⁴¹ Since the dawn of 'the golden age of electronics,' they have become capable of 'learning, intelligence, and creativity',⁴² and should be viewed in a way that is more appropriate to these characteristics. What Dawkins draws our attention to here is, firstly, the importance of the electronic age; secondly, that machines now have more of the characteristics normally associated with the 'natural' world; and thirdly, that the natural world is itself constituted of lots of highly complicated, biological machines. This last point is emphatically highlighted a little later on in his endnote:

People who think that robots are by definition more 'deterministic' than human beings are muddled (unless they are religious, in which case they might consistently hold that humans have some divine gift of free will denied to mere machines). If, like most of the critics of my 'lumbering robot' passage, you are not religious, then face up to the following question. What on earth do you think you are, if not a robot, albeit a very complicated one?⁴³

³⁹Dawkins, *Selfish Gene* 19-20.

⁴⁰Dawkins, *Selfish Gene* 270.

⁴¹Dawkins, *Selfish Gene* 270.

⁴²Dawkins, *Selfish Gene* 270.

⁴³Dawkins, *Selfish Gene* 270-71.

This is an explicit statement of the belief that the only difference between a machine and an organism is, ultimately, to do with the level of sophistication - the strict border between the two is not really maintainable. This is in direct contrast to the belief posited by Descartes three-hundred years ago, which I cited in the introduction. His musings about the difference between humans and automatons led him to the conviction that all aspects of the human could, in principle, be simulated in an automaton except the faculty of reason. This position can no longer be sustained because we have electronic machines which can perform certain incredible acts of calculation - they might not be able to 'think' like humans, but it is not inconceivable that they should do so in the future; at least, there is not such a gulf between human and machine that we cannot see that the machine mimics, at some level, the operations of the human brain.

The other major contemporary departure from the belief of Descartes' days, is that the harsh dividing line between species has been collapsed by Darwinism. Descartes saw reason as a faculty which not only separated humans from machines, but also from animals; now we have to acknowledge that the divisions between species are not so rigidly drawn, and that animals can be seen to have human faculties, albeit on a 'lower' level.⁴⁴

It ought also to be briefly noted that the determinism/free will boundary is also called into question when the natural/artificial boundary is contested. This comes out in a defence that Dawkins offers, at the close of his endnote, in response to misreadings of his 'lumbering robot' passage. These misreadings suggest that Dawkins is saying that genes 'control' us, body and mind, rather than that (as the passage actually says) they 'created' us. The distinction is extremely important because it makes clear that although genes did indeed create us, they do not directly control us, and this leaves us a measure of independence from them: 'We effortlessly (well, fairly effortlessly) defy them every time we use contraception.'⁴⁵ These sentiments find further expression in the dramatic closing sentences to the first edition of *The Selfish Gene* (the second edition includes two extra chapters): 'We are built as gene machines and cultured as meme machines, but we have the power to turn against our creators. We, alone on earth, can rebel against the tyranny of the selfish replicators.'⁴⁶ There is a pay-off

⁴⁴For example, in an article about the 1996 Tucson conference about consciousness, the *New Scientist* reported the work of various researchers who were exploring the language-forming skills of other species, commenting that 'recently the evidence has become much stronger that humans are not alone in using language and in forming abstract concepts.' Alun Anderson, Bob Holmes and Liz Else, 'Zombies, Dolphins and Blindsight,' *New Scientist* 4 May 1996: 21.

⁴⁵Dawkins, *Selfish Gene* 271.

⁴⁶Dawkins, *Selfish Gene* 201. *Memes* are invented by Dawkins as a way of talking about all the different things that make up culture ('tunes, ideas, ways of making pots,' etc.), and how they are transmitted. For more about this see chapter eleven of Dawkins' book, 'Memes: The New Replicators.' Dawkins, *Selfish Gene* 189-201.

between free-will and determinism here - it is, in the picture of life that Dawkins presents us, not useful to talk of either as an absolute category, at least not in relation to humans.

I have described the ways in which Dawkins invokes information technology in order to describe the actions of DNA. There is also one more way in which the natural is penetrated by the technological in his work. This comes in descriptions of individual organisms, and picks up on a longer tradition, wherein mechanical metaphors are deployed to describe humans and other creatures (an example of this would be the metaphor of the heart as a pump). In extending this traditional array of technological metaphors, Dawkins again stresses the centrality of information, and introduces metaphors drawn from information technology.

The difference between the two ways in which these metaphors are employed - to describe the flow of DNA down the ages, and to describe the individual creatures in which it resides - can be seen in the following passage from *The Blind Watchmaker*:

The information is transmitted vertically to other DNA in cells (that make other cells) that make sperms or eggs. Hence it is transmitted vertically to the next generation and then, vertically again, to an indefinite number of future generations. I shall call this 'archival DNA'. . . . DNA is also transmitted *sideways* or horizontally: to DNA in non-germ-line cells such as liver cells or skin cells; within such cells to RNA, thence to protein and various effects on embryonic development and therefore on adult form and behaviour.⁴⁷

The vertical transmission of information ties in with the sorts of metaphors I have already described, showing how DNA is transmitted from generation to generation. The horizontal transmission takes us towards means of describing the individual creature, which I will deal with now.

Interestingly, what is emphasised in the above passage is, yet again, the transmission of information, and the implication is that genetic information is the fundamental reality upon which the existence of organisms is based. This point is emphasised when Dawkins goes on to further explain these two modes of transmission by reference to a computer program which he designed to mimic certain aspects of natural selection: 'You can think of horizontal transmission and vertical transmission as corresponding to the two sub-programs called DEVELOPMENT and REPRODUCTION in Chapter 3.'⁴⁸

⁴⁷Dawkins, *Blind Watchmaker* 122.

⁴⁸Dawkins, *Blind Watchmaker* 122.

The 'development' aspect of DNA influence (which ties in with the use of technological metaphors to describe actual creatures, rather than just the genes which built them), is particularly apparent in 'The Gene Machine' chapter of *The Selfish Gene*. This begins with a description of the actions of muscles which mirrors the traditional, well-known metaphors of mechanism (like that of the heart as a pump) that have been used to describe bodies in the past:

Muscles are engines which, like the steam engine and the internal combustion engine, use energy stored in chemical fuel to generate mechanical movement. The difference is that the immediate mechanical force of a muscle is generated in the form of tension, rather than gas pressure as in the case of the steam and internal combustion engines. But muscles are like engines in that they often exert their force on cords, and levers with hinges. In us the levers are known as bones, the cords as tendons, and the hinges as joints.⁴⁹

This sort of metaphor has a long history, and its comparison of the human (or any other animal) body to a mechanical contrivance dates back a long way, and is not that far removed from the automaton imagined by Descartes.⁵⁰

However Dawkins' chapter introduces new mechanistic metaphors, based on information technology, for understanding the body, focusing not on the muscles themselves, but on how their movements are timed - in other words, on how a brain works. The specific image invoked in order to help us understand this, is that of the computer:

The axons [of some neurones] are usually bundled together in thick multi-stranded cables called nerves. These lead from one part of the body to another carrying messages, rather like trunk telephone cables. Other neurones have short axons, and are confined to dense concentrations of nervous tissue called ganglia, or, when they are very large, brains. Brains may be regarded as analogous in function to computers. They are analogous in that both types of machine generate complex patterns of output, after analysis of complex patterns of input, and after reference to stored information.⁵¹

⁴⁹Dawkins, *Selfish Gene* 47.

⁵⁰Bruce Mazlish gives an extended discussion of Descartes' conception of machines in which he makes a similar point to the one I am making here. He also contrasts the Cartesian machines with those described by Wiener, an issue I explore towards the end of this chapter. Bruce Mazlish, *The Fourth Discontinuity: The Co-Evolution of Humans and Machines* (New Haven: Yale UP, 1993) 19-26.

⁵¹Dawkins, *Selfish Gene* 49.

Here, again, because we are in the information age, we see the primary symbol of information-processing, the computer, invoked as a way of understanding a natural process - the dominant machine metaphor is electronic rather than mechanical now.⁵² As with the statement about survival machines being 'lumbering robots,' Dawkins has found himself under attack for using this metaphor. Again, he defends himself in an endnote:

Statements like this worry literal-minded critics. They are right, of course, that brains differ in many respects from computers. . . . This in no way reduces the truth of my statement about their being analogous in function. Functionally, the brain plays precisely the role of on-board computer - data processing, pattern recognition, short-term and long-term data storage, operation coordination, and so on.⁵³

What the metaphor of the brain as a computer allows Dawkins to do, is to articulate in a powerful way the function that brains play in the survival of genes into the next generation: 'By dictating the way survival machines and their nervous systems are built, genes exert ultimate power over behaviour. But the moment-to-moment decisions about what to do next are taken by the nervous system. Genes are the primary policy-makers; brains are the executives.'⁵⁴ Computers provide compelling ways of understanding the processing of information. As a species which distinguishes itself from others in terms of brain size, it is hard to avoid the conclusion that we are, more than anything, information-processing creatures.

The difference between the metaphor used here, and that used to describe DNA as a digital information storage system, is that, in the earlier instance, there was something intrinsic to the way that DNA stores information that made the comparison more than a metaphor. Here, the metaphorical status of the 'brain as computer' is a little more obviously foregrounded: 'The basic unit of biological computers, the nerve cell or neurone, is really nothing like a transistor in its internal workings.'⁵⁵ Nevertheless, the difference between the thing being described, and the metaphor used

⁵²The metaphor of the brain as a computer has also informed work in cognitive psychology. For example, in an introduction to the field, Anthony J. Sanford writes that cognitive psychology often denotes a philosophical approach to the subject 'termed the *information processing* approach, and it has several important characteristics. First, it views those activities which make up mental events as reflecting a flow of information. . . . Secondly, such an approach implies a rather mechanistic view of the mind: it is seen as an automaton. The complexity of that automaton is very great, greater than the most flexible of modern computers, which many see as analogous to the mind.' Anthony J. Sanford, *Cognition and Cognitive Psychology*, Weidenfeld Psychology Ser. (London: Weidenfeld, 1985) 1-2.

⁵³Dawkins, *Selfish Gene* 276.

⁵⁴Dawkins, *Selfish Gene* 60.

⁵⁵Dawkins, *Selfish Gene* 48.

to describe it, lies, again, only in the degree of sophistication: 'Certainly the code in which neurones communicate with each other seems to be a little bit like the pulse codes of digital computers, but the individual neurone is a much more sophisticated data-processing unit than the transistor. Instead of just three connections with other components, a single neurone may have tens of thousands.'⁵⁶ As with the descriptions of DNA, the comparison of brains with electronic technology seems, at times, to go beyond the purely metaphorical.

Border Disputes along the Natural/Artificial Divide: (ii) Living Machines

The reverse process, whereby the artificial is penetrated by the natural, also takes place in both Gibson's and Dawkins' work. With Dawkins this is far less pronounced because he is seeking to explain to the lay reader how evolution works, and so is primarily concerned with what we normally think of as alive and natural, and not with machines. Nevertheless, in order to explain some points he draws out analogies between machines and organisms (some of which we have already seen), and in the process passes comment upon machines.

For instance, in the 'Gene Machine' chapter referred to above, where Dawkins discusses the function of brains as computers that take executive decisions in order to ensure the survival of the organism's genes into the next generation, he draws out a number of analogies with various machines in order to make certain points. One of these is that organisms (survival machines) engage in apparent purposive behaviour. We do not know if animals are conscious or not, but we can talk about them as if they are because they engage in activities which seem to be motivated by a purpose - the question of whether they actually are conscious or not can be left open. This Dawkins illustrates by an analogy, explaining that it is useful to talk about machines as if they are conscious, even though we know they are not:

[I]t does not matter for our present purposes [whether survival machines are conscious] because it is easy to talk about machines that behave *as if* motivated by a purpose, and to leave open the question whether they are conscious. These machines are basically very simple, and the principles of unconscious purposive behaviour are among the commonplaces of engineering science. The classic example is the Watt steam governor.⁵⁷

The analogy with the Watt steam governor, which regulates the rate at which an engine works, shutting steam off when it goes too quickly, and increasing steam to it when it

⁵⁶Dawkins, *Selfish Gene* 48.

⁵⁷Dawkins, *Selfish Gene* 50.

goes too slowly, is pertinent. It provides a justification for talking about animals as if they are conscious, regardless of whether they are or not. This justification proceeds in a curious (though completely justified way): because real machines behave in a way that seems to be conscious (even though we know that it is not), it is reasonable to talk about living things as though they are conscious (even though we do not really know whether they are), because they are like machines in this respect.

So, for an instant, we are asked to imagine that machines are conscious: 'The "purpose machine", the machine or thing that behaves as if it had a conscious purpose, is equipped with some kind of measuring device which measures the discrepancy between the current state of things, and the 'desired' state. It is built in such a way that the larger this discrepancy is, the harder the machine works.'⁵⁸ Dawkins then goes on to show how more advanced machines (the examples he uses are guided missiles and chess computers) 'achieve more complex "lifelike" behaviour.'⁵⁹ There is never the implication that these actually are conscious or alive, and in this respect Dawkins cannot go as far as Gibson who, as we shall see, imagines a future where machines really do achieve sentience. Nevertheless, although Dawkins does not invoke machines as living things ('[t]he "desired" state of the Watt governor is a particular speed of rotation. Obviously it does not consciously desire it'),⁶⁰ he makes passing reference to the life-likeness of machines in order to show how it is fruitful to think of organisms as purposeful machines. Natural and artificial are merged, to a degree, here.

The point is rather more forcefully made in *The Blind Watchmaker*. In this book Dawkins' approach to evolution is through William Paley's treatise of 1802, in which he argued that, just as one assumes the existence of a watch-maker when one sees a watch, so we can assume the existence of a god-like creator when we find complex designed objects (living creatures) in the world. Dawkins' book is dedicated to showing how the theory of evolution is all that we need to explain the existence of life on earth - the deity supposed by Paley is irrelevant to the question. He therefore starts off with a chapter '[e]xplaining the very improbable,'⁶¹ in order to make clear that a religious explanation is not needed to account for the existence of complex life-forms on earth. On the very first page he suggests a novel way of looking at machines:

At first sight, man-made artefacts like computers and cars will seem to provide exceptions [to the simple things studied by physics, which don't tempt us to invoke design, and the complex things, studied by

⁵⁸Dawkins, *Selfish Gene* 50.

⁵⁹Dawkins, *Selfish Gene* 51.

⁶⁰Dawkins, *Selfish Gene* 51.

⁶¹Dawkins, *Blind Watchmaker* 1-18.

biology, which look as if they are designed for a purpose]. They are complicated and obviously designed for a purpose, yet they are not alive, and they are made of metal and plastic rather than of flesh and blood. In this book they will be firmly treated as biological objects.⁶²

Here machines are described as 'biological objects'; a few pages further on they are referred to as 'honorary living things.'⁶³ Dawkins' purpose is not, of course, to argue that these machines actually are alive - he is making a point about how we seek to explain things that appear to be consciously designed. Nevertheless, it is interesting that the natural and the artificial are used together in this way. Gibson, in his creation of a futuristic imaginary world, pushes this sense of living machines much further.

They crop up in two main ways in his novels, with technological artefacts coming to life, and with multinational corporations being treated as living entities. I will begin with the first of these as it offers the most direct route to an understanding of the border transgressions from the natural to the artificial in Gibson's work.

I have already mentioned the constructs which encode people's personalities. As well as viewing these as people who become machines, we could equally well see them as machines that come to life. This latter perspective is certainly apposite for making sense of the AIs which lie behind so many of the events in the novels. Indeed, if there is a common story which evolves over the course of the three books, it is a story about AIs - electronic machines - achieving sentience. One of the mysteries in *Neuromancer* is about who is in ultimate control of the operation which Case and Molly are employed to take part in. Initially it seems to be Armitage, who approaches them personally, but they then discover that Armitage is merely a pawn being manipulated by an AI, known as Wintermute, that may even have reconstructed Armitage's personality for him.

As with the constructs, questions are raised about sentience and what distinguishes that which is alive from that which is wholly artificial. This comes across when Case meets Wintermute in a sort of virtual reality scenario, the AI revealing a little more of the mystery to Case, and trying to explain the mystery of its own existence to him:

[I'm an] artificial intelligence, but you know that. Your mistake, and it's quite a logical one, is in confusing the Wintermute mainframe, Berne, with the Wintermute *entity* [...]. You're already aware of the other AI in Tessier-Ashpool's link-up, aren't you? Rio. I, insofar as I

⁶²Dawkins, *Blind Watchmaker* 1.

⁶³Dawkins, *Blind Watchmaker* 10.

have an 'I' - this gets rather metaphysical, you see - I am the one who arranges things for Armitage.⁶⁴

The positing of an 'entity' separate from the physical hardware conjures up associations with Descartes' distinction between body and mind. There is something about the AI which Gibson wants to suggest really is, in some sense, alive. One could read the positing of this separate 'entity,' or mind, as either conservative or radical in the extent to which it transgresses the binary distinction between the natural and the technological: it is conservative if one sees it as reinscribing the old mind/body dualism into these new living things; and it is radical if one sees it as transgressing the mind/body divide by suggesting that a living 'entity' arises spontaneously from the computing hardware and software.

Eventually it is revealed that Molly and Case are being used by Wintermute to launch an attack upon itself, cutting the mechanisms which prevent it from growing and getting any smarter, and allowing it to join up with the other AI in Rio. When Case is briefly arrested by agents for the Turings, who police computer matters, one of them suggests that by cutting Wintermute's shackles Case will allow it to come alive in a dramatic way: 'You have no care for your species. For thousands of years men dreamed of pacts with demons. Only now are such things possible [...] What would your price be, for aiding this thing to free itself and grow?'⁶⁵

In another virtual conversation with Wintermute, who has taken on the guise of one of Case's accomplices on the project, the point that Wintermute is alive is made more forcefully:

He reached into the exposed chassis of an ancient television and withdrew a silver-black vacuum tube. 'See this? Part of my DNA, sort of [...] You're always building models. Stone circles. Cathedrals. Pipe-organs. Adding machines. I got no idea why I'm here now, you know that? But if the run goes off tonight, you'll have finally managed the real thing.'⁶⁶

When Case expresses confusion, Wintermute explains further: 'That's "you" in the collective. Your species.'⁶⁷ The 'real thing' is presumably creating more than a model, something that is actually alive - the description of a vacuum tube as a 'sort of' DNA reinforces this point.

⁶⁴Gibson, *Neuromancer* 145.

⁶⁵Gibson, *Neuromancer* 193.

⁶⁶Gibson, *Neuromancer* 204.

⁶⁷Gibson, *Neuromancer* 204.

Case and Molly's assault on the system is successful, but the second book does not develop these ideas of sentience much further, except to introduce the 'biochip,' another merging of the artificial and the natural; the character of Angie who, we will discover in the final book, has been manipulated by an AI; and manifestations of strange, inexplicable occurrences on the matrix. These occurrences, interpreted in terms of the supernatural, as voodoo, suggest that the matrix is being seen as more than just an artificial construct and is, possibly, being invested with some lifelike properties.

It is indeed this last explanation which is provided in the final book of the series. Angie, one of the principal characters, tries to find out about the time known as 'When It Changed,' when the matrix started behaving strangely, just after Case and Molly's successful operation in *Neuromancer*. She is told that When It Changed is a mythform usually encountered,

in one of two modes. One mode assumes that the cyberspace matrix is inhabited, or perhaps visited, by entities whose characteristics correspond with the primary mythform of a 'hidden people'. The other involves assumptions of omniscience, omnipotence, and incomprehensibility on the part of the matrix itself.⁶⁸

In other words some assume the matrix to be more than just the sum of the individual computers which comprise it. A possible explanation for this is offered by Molly who recounts Case's theory about what happened to Wintermute: '[Case] had this idea that it was gone, sort of; not *gone* gone, but gone *into* everything, the whole matrix. Like it wasn't *in* cyberspace anymore, it just *was*.'⁶⁹ In other words it has achieved lifelike properties.

The operation for which Case and Molly were employed in the first book has freed the AI, which has gone into the matrix and achieved a sort of sentience, perhaps even a supernatural existence of some kind. The machine has become more than a machine, the biochip being the key component. Angie has this explained to her in a dream-like vision:

In the hard wind of images, Angie watches the evolution of machine-intelligence: stone circles, clocks, steam-driven looms, a clicking brass forest of pawls and escapements, vacuum caught in blown glass, electronic hearthglow through hair-fine filaments, vast arrays of tubes and switches decoding messages encrypted by other machines . . . The fragile, short-lived tubes compact themselves, become transistors; circuits integrate, compact themselves into silicon . . .⁷⁰

⁶⁸Gibson, *Mona Lisa* 138.

⁶⁹Gibson, *Mona Lisa* 175.

⁷⁰Gibson, *Mona Lisa* 263.

This constitutes the thread of storyline which links the three novels: the erosion of the strict binary division between human and machine as the machine achieves sentience. The actual living experience of the machine is, however, always concealed from the reader, and only accessed through the attempts by the constructs or AIs to explain what it is to exist to the human characters - as though it is impossible to conceive of this other non-human intelligence. In this sense the 'mystery' of consciousness is preserved. The point at which the nonliving becomes living is beyond comprehension, and Gibson resists the temptation to attempt explaining it.

Gibson's presentation of the corporations which dominate the world that he imagines is the other main way in which the natural/artificial divide is breached. They are almost living organisms themselves, taking on a life of their own which is independent of the people who populate them. In *Count Zero*, for example, Josef Virek's wealth has multiplied to the point where it seems to grow and pursue its own ends: 'Aspects of my wealth have become autonomous, by degrees; at times they even war with one another. Rebellion in the fiscal extremities.'⁷¹ Virek himself only exists in a vat which keeps him alive, and his only contact with the 'real' world is through various forms of virtual reality. Looking at one of these virtual constructs, Marly senses the existence of a non-human life-form: 'And, for an instant, she stared directly into those soft blue eyes and knew, with an instinctive mammalian certainty, that the exceedingly rich were no longer even remotely human.'⁷²

Similarly, in *Mona Lisa Overdrive*, the media corporation Sense/Net is found not to be run by its nominal human head, Hilton Swift, but by the AI Continuity who appeared, initially, to be nothing more than a high-tech personal assistant: 'Hilton Swift is obliged to implement Continuity's decisions. Sense/Net is too complex an entity to survive, otherwise, and Continuity, created long after the bright moment [When It Changed], is of another order.'⁷³ Interestingly, Continuity's motives are nothing more than continued existence - the only 'purpose' which Dawkins allows us to subscribe to genes. The whole point of the selfish-gene theory is that those genes that act in a way which benefits their survival will be those which last longest - there is no conscious purpose here; it is just that those which are better at surviving will be those which, on the whole, tend to survive. This very point seems to be being made about Continuity, who runs things merely in order to survive: 'Continuity is continuity. Continuity is

⁷¹Gibson, *Count Zero* 26.

⁷²Gibson, *Count Zero* 29.

⁷³Gibson, *Mona Lisa* 265.

Continuity's job . . .'⁷⁴ This sentence could be applied to Dawkins' selfish genes - their purpose, as much as it can be described as such, is continuity.

In *Neuromancer* Case muses upon this biological nature of corporations:

Power, in Case's world, meant corporate power. The zaibatsus, the multinationals that shaped the course of human history, had transcended old barriers. Viewed as organisms, they had attained a kind of immortality [...] [W]eren't the zaibatsus more like that ... hives with cybernetic memories, vast single organisms, their DNA coded in silicon?⁷⁵

What makes the description of the corporations as alive so potent, is the equation that is made in this quotation, and throughout the books, between life (DNA), machine (silicon), and corporation (multinationals). The corporations have grown to such an extent that they act as though they really are alive, with an existence independent of (and more than that of) their individual human and machine parts.

Conclusion

So Gibson imagines a world where living things have become more like machines, and machines have become more like living things. He presents us with a vision of a world where the boundaries between the natural and the artificial are permeable, and there is no absolute definition of what is and is not alive to which we can aspire.

This is significant in terms of the postmodern literature/science discourse, partly because it ties in with the loss of the sharp distinction between observer and observed. No longer can we imagine, as Descartes did, a mind which sits apart from the world of matter, linked to it only by the pineal gland. Instead, mind very much is matter - minds are extended by electronic enhancements, and electronic machines give birth, in an emergent way, to minds.

This may seem a long way from the reality of our contemporary world, and from the descriptions of evolution which Richard Dawkins produces, where information technology is used as a metaphor to explain how DNA works. However, it is important to realise that his use of information technology is not just a literary conceit, used to explain a technical detail to the lay reader. There is something about

⁷⁴Gibson, *Mona Lisa* 265.

⁷⁵Gibson, *Neuromancer* 242. The same point is made more explicitly in one of Gibson's short stories, 'The New Rose Hotel,' in which Fox claims that the 'blood of a zaibatsu is information, not people. The structure is independent of the individual lives that comprise it. Corporation as life form.' *Burning Chrome' and Other Stories* (London: HarperCollins, 1995) 129.

DNA which makes it, in a literal sense, an information technology. One of the definitions of life which Dawkins gives, illustrates this perfectly: 'There is no spirit-driven life force, no throbbing, heaving, pullulating, protoplasmic, mystic jelly. Life is just bytes and bytes and bytes of digital information.'⁷⁶ Life is not, in this understanding of it, imbued with any mystical qualities, and we need to alter our conceptions of it if we aspire to discuss these issues in an accurate manner.

This is important: the difference between the living and the non-living is not an essential one, but merely a difference in the level of complexity. What makes a living thing alive is that it is created by a highly complex digital information system. What Dawkins is trumpeting here is a change in the metaphors that we use to describe life - perhaps, indeed, it spells the end of attempts to imbue life with any mystical qualities, be they a soul, the detached mind proposed by Descartes, or the 'spark of being'⁷⁷ which Frankenstein is imagined to use to imbue his creature with life. In the cybernetic age, information, not mysticism, lies at the core of life:

What lies at the heart of every living thing is not a fire, not warm breath, not a 'spark of life'. It is information, words, instructions. If you want a metaphor, don't think of fires and sparks and breath. Think, instead, of a billion discrete, digital characters carved in tablets of crystal. If you want to understand life, don't think about vibrant, throbbing gels and oozes, think about information technology.⁷⁸

This shift in conceptions of life is impossible to date precisely. However, it is reasonable to argue that it comes about in the second half of the twentieth century, and therefore ties in with Lyotard's claim, which I referred to in the last chapter, that postmodern discourses have arisen during the last fifty years. A key early text must be Norbert Wiener's *The Human Use of Human Beings*, first published in 1950. Wiener was prominent in developing the theory of communication and control mechanisms in both organisms and machines, and coined the term *cybernetics*.

The Human Use of Human Beings is a popularised version of his earlier work, *Cybernetics*, and in it we can find an early sense of the equivalence of the electronic and the organic, which later flowers into Dawkins' and Gibson's presentations of the issue. Throughout the book, Wiener writes about notions of communication, control, and the processing of information, arguing that they are essentially the same whether we choose to consider them in relation to machines, humans, or societies. He even addresses the problems of defining the word *life* accurately, and the difficulties of using

⁷⁶Dawkins, *River* 18-19.

⁷⁷Mary Shelley, *Frankenstein: Or, The Modern Prometheus* (1818; London: Penguin, 1985) 105.

⁷⁸Dawkins, *Blind Watchmaker* 112.

it to distinguish between humans and machines: 'Here I want to interject the semantic point that such words as life, purpose, and soul are grossly inadequate to precise scientific thinking. . . . Now that certain analogies of behavior are being observed between the machine and the living organism, the problem as to whether the machine is alive or not is, for our purposes, semantic. . . .'⁷⁹ Wiener then goes on to describe the ways in which the new machines, being developed during the middle of the century (the forerunners of computers), are like living things: they are islands of order, becoming more organised against a background of increasing entropy; they possess effector organs (similar to limbs) in order to carry out their tasks; they possess sense organs to monitor their environment; and as a result of these characteristics they are able, through feedback, to monitor and respond to the effects that they have on the local environment. Consequently, 'the nervous system and the automatic machine are fundamentally alike in that they are devices which make decisions on the basis of decisions they have made in the past.'⁸⁰

Furthermore, Wiener distinguishes between two kinds of machines. The older sort, which he terms Leibnitzian, 'saw the whole world as a collection of beings called "monads" whose activity consisted in the perception of one another on the basis of a pre-established harmony laid down by God.'⁸¹ These can be seen to fit into the mechanical view of the universe proposed by Laplace, and to accord with traditional, strictly mechanical metaphors of bodies as machines, and the older conceptions of robots, which Dawkins derides as 'rigidly inflexible morons' in the second edition of *The Selfish Gene*. The new sort, being developed at the middle of this century, are more analogous to living creatures. Wiener's presentation of them brings to mind the adaptive, growing machine intelligences of Gibson's *Neuromancer* trilogy, and Dawkins' emphasis on 'learning, intelligence, and creativity' in modern robots:

Certain kinds of machines and some living organisms . . . can, as we have seen, modify their patterns of behavior on the basis of past experience so as to achieve specific anti-entropic ends. . . . In other words, the organism is not like the clockwork monad of Leibnitz with its pre-established harmony with the universe, but actually seeks a new

⁷⁹Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society*, 2nd ed. (1950; London: Eyre and Spottiswoode, 1954) 31-32. One of the examples that Wiener cites to illustrate this is the problem of whether viruses are, properly considered, alive, given that they only have some of the characteristics of living things. In recent years a mirror-image of this dilemma has arisen in computing, where living metaphors are used to describe problems that beset computers - computer 'viruses' can 'infect' networks, and you can even get a Norton Disc 'Doctor' to cure your machine.

⁸⁰Wiener 33.

⁸¹Wiener 18.

equilibrium with the universe and its future contingencies. Its present is unlike its past and its future unlike its present.⁸²

So it is with the technological developments of the mid-twentieth century, and the new perception of humans and machines which they facilitated (and were facilitated by), that we can see the roots of the postmodern discourses I have discussed in this chapter.

Paul Davies and John Gribbin's presentation of contemporary science in *The Matter Myth* provides further evidence for this sort of paradigm shift. Although they make no reference to postmodernism, their contention that the way of looking at the world, in the sciences, has changed, ties in with my suggestion in this chapter that mechanical and organic are becoming entwined. For instance, they label their final chapter, 'The Living Universe,' and earlier on in their book contend that the language of science has shifted from a mechanical to an organic vocabulary:

This burgeoning study of nonlinear systems is causing a remarkable shift of emphasis away from inert 'things' - lumpen matter responding to impressed forces - and towards 'systems' that contain elements of spontaneity and surprise. The old machine vocabulary of science is giving way to language more reminiscent of biology than physics - adaption, coherence, organization, and so on.⁸³

These changes do, indeed, as Porush has argued, suggest that we are living in an increasingly cybernetic age.

⁸²Wiener 48.

⁸³Davies and Gribbin 55.

CHAPTER 7 - DISCOURSES OF TIME

In recent decades, evolutionary biology has witnessed a shift, as it were, from modern romance to postmodern picaresque as the most compelling way to plot the history of life on this planet.¹

In 'The End of Metanarratives in Evolutionary Biology,' from which this quotation is taken, Eric White argues that many contemporary narratives of evolution are characterised by a postmodern attitude towards time. The cultural ethos of modernity stressed the 'attainability of perfection,'² and so saw change over time as progress towards this perfect state. Postmodern narratives, on the other hand, suggest that there is no intrinsic direction to history, and therefore renounce this sort of progress: 'history, from the standpoint of modernity . . . approximates to a comic romance in which the hero's final triumph is assured from the beginning of the tale. Postmodernity, on the other hand, entails the view that no fixed direction has been inscribed in history from its outset.'³ White goes on to argue that these differences dictate that modernist narratives of evolution employ one of two narrative forms (comic romance, or tragic romance), both of which imply a mastery (either symbolic or actual) of nature, whereas postmodernist versions, which replace them, tend to adopt a picaresque form which eschews mastery.

It is this new understanding of time that I will investigate in this chapter, suggesting that we can find it in both contemporary literature and science writing. My argument will differ from White's in one or two details. The most important of these is a slight modification of the postmodern attitude towards time which he presents. He sees 'no fixed direction' inscribed in history at the outset, and cites chaos theory as an example: 'the end can no longer be said to reside in the beginning because stochastic departures from the past behavior of a system remain an ever-present possibility.'⁴ This rather over-simplifies the presentation of chaos theory in science writing. It is not so much that the beginning does not affect the end, as White is claiming here, as that we cannot know the beginning in enough detail to predict what will happen at the end. Chaos theory stresses 'sensitive dependence on initial conditions,' not 'no dependence on initial conditions' or even 'partial dependence on initial conditions.' To predict the

¹Eric White, 'The End of Metanarratives in Evolutionary Biology,' *Modern Language Quarterly* 51 (1990): 64.

²White, 'End of Metanarratives' 63.

³White, 'End of Metanarratives' 63.

⁴White, 'End of Metanarratives' 64.

behaviour of a chaotic system we would need infinite accuracy in our measurement of that system - that this is theoretically, as well as practically, impossible, does not mean that the beginning does not affect the end. What it does mean is that our predictions of the end are fundamentally limited; indeed, that anything except short-term prediction may be impossible. It is nevertheless important to realise that chaos theory does not mean that the evolution of a system is completely random.

This is important for our appreciation of contemporary narratives of the history of life, because, whereas White stresses that evolutionary development is marked by chance, my reading of these narratives is that evolution is not truly random, but that at each stage contingent circumstances may take it off in different directions: the end does reside in the beginning, but there is no way of knowing what that end will be. I therefore agree with White's broader point, that contemporary narratives tend not to present a general direction in which evolution moves.

My scientific text for this section is Stephen Jay Gould's *Wonderful Life: The Burgess Shale and the Nature of History*. White refers to Gould, and his collaborator Niles Eldridge, as scientists who have produced examples of the new postmodern discourse in their formulations of the theory of 'punctuated equilibrium,' which stresses a view of natural history where evolution is not constituted by continual steady progress, but is composed instead of periods of relative equilibrium, interspersed with times of rapid change and speciation. Quite how revolutionary this theory is is open to debate - for instance Dawkins, the subject of my last chapter, writes persuasive dismissals of the claims made by Eldridge and Gould to have produced a substantially new picture of evolution.⁵

However, as in my previous chapters, I do not intend to overstep the bounds of my expertise and comment upon the truth, or otherwise, of competing scientific claims. What is justifiable is to state that Gould is an important contributor to the public scientific discourses of evolution - whether punctuated equilibrium is 'right' or not - and *Wonderful Life* represents an intriguing articulation of his view of evolution. What I will demonstrate in this chapter is that it has all the hallmarks of a postmodern discourse, and that it shares these hallmarks with postmodern literature.

The literature I shall be dealing with in this chapter is a sequence of Kurt Vonnegut's novels, selected to illustrate an evolving conception of time: *Player Piano* (1952), *The Sirens of Titan* (1959), *Cat's Cradle* (1963), *Slaughterhouse-Five* (1969), *Breakfast of Champions* (1973) and *Galápagos* (1985). I intend to show how

⁵See especially, chapter 9, 'Puncturing Punctuationism,' in *The Blind Watchmaker* (referenced above). It should be stressed that Dawkins' objection to Gould is not so much that he is wrong, as that he restates what evolutionary biologists have always known in terms which make the ideas appear to be revolutionary and new.

Vonnegut arrives at a similar presentation of time and, in *Galápagos*, of evolution, independently of Gould.

This last novel, dealing directly with evolution as it does, is an obvious choice for a comparison with Gould's book - all the more so as Gould claims that 'I would (and do) assign it to students in science courses as a guide to understanding the meaning of contingency [in evolution].'⁶ Furthermore, Vonnegut refers, in the novel, to the twentieth century as "the Era of Hopeful Monsters", with most of the monsters novel in terms of personality rather than body type.⁷ The phrase 'hopeful monsters' was coined by Richard Goldschmidt, who proposed nonconformist, Saltationist views of evolution in the 1930s and 1940s, and whose reputation Gould and Eldridge have attempted to revive.⁸ Vonnegut seems, therefore, to be allying himself very directly with a particular view of evolution: that described by White as postmodern.

What I shall demonstrate is that this outlook upon the notion of change over time does not only appear in *Galápagos*, in which Vonnegut deals directly and consciously with evolution. The genesis of these ideas about time, progress and teleology lies right back in Vonnegut's earlier novels, and evolves over the course of his *oeuvre*. What we are dealing with, therefore, is not just a writer responding directly to a scientific idea that he finds interesting, but the separate emergence of similar ideas about time in different areas of the culture. The direct link between science and literature in *Galápagos* emerges *after* the idea has developed separately in his fiction, and in science writing about evolution.

I shall begin by demonstrating the ways in which Vonnegut's presentation of evolution in *Galápagos* is equivalent to that proposed by Gould in *Wonderful Life*. The point of this is to show that in writing a novel about evolution, Vonnegut has responded to a specific contemporary scientific view of the subject. In this sense I will be describing a direct link between literature and science.

However, I will then go on to show how the view of time which is implied by this presentation of evolution, has its roots not only in science, but in Vonnegut's earlier novels. I will trace its development from *Player Piano* through to *Breakfast of Champions*, the novel which precedes *Galápagos* in the sequence I am interested in.

⁶Gould, *Wonderful Life* 286.

⁷Vonnegut, *Galápagos* (1985; London: Grafton-Collins, 1987) 78.

⁸Saltationism proposed that evolution takes place in large-scale steps, rather than more gradually. For a more detailed description of the theory, and for Dawkins' arguments as to why it could not work, and why he thinks that Gould and Eldridge are not really, despite their claims, supporting Saltationism, see 'Puncturing Punctuatedism' in *The Blind Watchmaker* (referenced above). It should be noted that Gould does not advocate an unqualified acceptance of Goldschmidt's views - see, 'Return of the Hopeful Monster,' *The Panda's Thumb* (New York: Norton, 1980) 186-93; and a reference to Goldschmidt in 'Evolution as Fact and Theory' (253-62) in *Hen's Teeth and Horse's Toes* (1983; London: Penguin, 1990) 260.

The point of doing this is to show that, although it is reasonable to suppose a fairly direct link between *Galápagos* and Gould's views of evolution, the concept of time implied by both arises separately and, for Vonnegut, has its origins much earlier on in his work. The view of evolution that he gives us in *Galápagos* is not something completely new then, but is rather a means of expressing ideas about time that have been important to him throughout his writing career.

Equivalent Presentations of Evolution in Science and Literature: Stephen Jay Gould's *Wonderful Life* and Kurt Vonnegut's *Galápagos*.

I have already shown that there are specific references in Vonnegut's novel that imply that he is drawing on a view of evolution similar to that proposed by Gould. In this section I will describe in detail the two main elements of this view of evolution: a rejection of simplistic notions of progress; and their replacement by a sense in which development over time is determined by contingency.

The first involves positing a history of ideas in which older notions of progress are replaced by new ideas about evolution, much as the discourses I discussed in chapters five and six necessitated the replacement of older conceptions of knowledge and identity. Simplistic notions of progress in evolution are supplanted as less straightforward drives are emphasised. This comes out particularly strongly in Gould's work in a sub-section of chapter one, 'The Ladder and the Cone: Iconographies of Progress,'⁹ which analyses popular representations of evolution, and includes an enlightening discussion of cartoon depictions of the march of evolution towards the emergence of humans. Here, Gould suggests that '[t]he march of progress is *the* canonical representation of evolution - the one picture immediately grasped and viscerally understood by all.'¹⁰ Indeed, this particular perception has become so all-pervasive that evolution and progress have become interchangeable terms: 'The straitjacket of linear advance goes beyond iconography to the definition of evolution: the word itself becomes a synonym for *progress*.'¹¹

It is this association of evolution with progress that Gould's work distances itself from. In doing so it implies an intellectual history for itself which is similar to that elucidated in the first section of this thesis. It is similar because the rejection of progress - the placing of 'evolution-as-progress' as a prior viewpoint - is associated with a rejection of the idea that truth accords directly with a simplistic, human-centred

⁹Gould, *Wonderful Life* 27-45.

¹⁰Gould, *Wonderful Life* 31.

¹¹Gould, *Wonderful Life* 32.

perspective on meaning: 'I don't think that any particular secret, mystery, or inordinate subtlety underlies the reasons for our allegiance to these false iconographies of [progress]. . . . They are adopted because they nurture our hopes for a universe of intrinsic meaning defined in our terms.'¹²

By rejecting progress, therefore, Gould is embracing, instead, a more open sense of purpose, and rejecting the notion that we can aspire to an objective truth which is centred around humans. This ties in with a 'postmodern' view of the world because it rejects the idea that we can centre our understanding of it upon ourselves and assume that this is the 'Truth' - we have to be more open to other viewpoints.

Gould is not of course proposing this for purely ideological reasons - it is based upon a desire to find a more adequate or correct view of evolution; 'truth' rather than 'Truth' perhaps. Nevertheless, it inevitably feeds into, and maybe draws from, the contemporary literature/science discourse and in so doing becomes ideological.

This same rejection of progress also appears in Vonnegut's presentation of evolution in *Galápagos*. Like *Wonderful Life* the novel situates itself in a certain history of ideas, distancing itself from a previous position. Again, this prior position consists of a human-centred concept of progress. This appears in the novel in a number of ways, most specifically in terms of the idea, derided by Vonnegut, that the human brain marks an evolutionary advance. Just as White suggests that older, 'modern' narratives of evolution were marked by their adherence to an intellectual, and actual, mastery of nature by human brains, so *Galápagos* mocks a similar viewpoint, relegating human brains from being the *telos* of evolution, to being just one, among many, evolutionary anomalies.

Two examples will suffice to illustrate this. Mary, a character who will eventually be stranded on the island of Santa Rosalia, along with the only other survivors of bacteria which wipe out human life elsewhere, is a school teacher. Vonnegut highlights the misconceptions about evolution-as-progress that she passes on to her students by contrasting her assertion that the human brain is a superb achievement by evolution, with the ways in which her own brain lets her down: 'Mary had also taught that the human brain was the most admirable survival device yet produced by evolution. But now her own big brain was urging her to take the polyethylene garment bag . . . and to wrap it around her head, thus depriving her cells of oxygen.'¹³

Another example lies in Vonnegut's association of brains with various forms of deceit and highly changeable opinion. This comes out in his description of the tourist

¹²Gould, *Wonderful Life* 43.

¹³Vonnegut, *Galápagos* 30. Mary's classes on natural history do also contain elements which conform with the 'postmodern' view of evolution, as we shall see later on.

boom enjoyed by the Galápagos islands. They become highly prized, not because there is any actual material change in their value, but simply because Darwin presents them as being valuable:

Darwin did not change the islands, but only people's opinion of them. That was how important mere opinions used to be back in the era of great big brains.

Mere opinions, in fact, were as likely to govern people's actions as hard evidence, and were subject to sudden reversals as hard evidence could never be. So the Galápagos Islands could be hell in one moment and heaven in the next, and Julius Caesar could be a statesman in one moment and a butcher in the next . . . and the universe could be created by God Almighty in one moment and by a big explosion in the next - and on and on.¹⁴

Vonnegut is highlighting the fallibility of brains here and, like Mary's betrayal by her suicidal brain, this throws into doubt a view of evolution which places humans at its apex, and reads natural history as a progression towards the evolution of brains as 'the most admirable survival device yet produced.'

In the conditions in which Vonnegut leaves his only surviving humans, on Santa Rosalia, brains cease to be a valuable evolutionary commodity. Rather mundanely, those who do best in the new environment are those who are physically best equipped for catching fish. Indeed, the ghost of Leon Trout, who narrates the novel from a million years in the future (and who is the son of Kilgore Trout, the terrible science fiction writer who also appears in *Slaughterhouse-Five* and *Breakfast of Champions*), defines humans, not by their intelligence, as Descartes and others did, but rather as fisherfolk. The only difference between our time and that of the novel is that in the contemporary world humans make their livings fishing metaphorically for wealth. By the end of the novel they are literal fishers, having evolved fur and flippers, and having lost their big brains: 'And now it appears to me that the tale I have to tell, spanning a million years, doesn't change all that much from beginning to end. In the beginning, as in the end, I find myself speaking of human beings, regardless of their brain size, as fisherfolk.'¹⁵

So Trout (perhaps the name is not coincidental!) defines humans not in terms of their intelligence, but by how they survive long enough to mate and reproduce - by the end of the novel this is by fishing. Evolution does not, therefore, involve a grand progression towards increasing sophistication and intelligent life. Rather, it is mere

¹⁴Vonnegut, *Galápagos* 22-23.

¹⁵Vonnegut, *Galápagos* 51.

short-term adaptation and perpetuation of the species. This implies a lack of purpose in the world - an important subject which we can explore by examining the second characteristic of evolution, according to Vonnegut's and Gould's narratives.

The first was the rejection of progress, understood in a simplistic way. The second is its replacement by a new drive to evolution, which we might term 'determined chance,' or as Gould puts it, *contingency*. It involves treading a line between seeing evolution as either wholly determined, or wholly undetermined. Gould states this succinctly, when he says that rejecting traditional notions of strict, consistent determinism, does not involving accepting complete randomness: '[r]ejection of ladder and cone [iconographies of progress] does not throw us into the arms of a supposed opposite - pure chance in the sense of coin tossing or of God playing dice with the universe.'¹⁶

In this rejection of both complete determinism, and its opposite, total chance, the 'postmodern' view necessitates the disruption of a binary opposition, just as my examples in the previous chapters did. To explain the history of life as either progress towards a goal, or its opposite, total randomness, is inadequate and fails to do justice to the complex factors that drive change over time. The disruption of this binary opposition may not have the 'soundbite' quality of the order versus disorder, global versus local, or human versus machine conflicts, but it is of a fundamentally similar character.

I have already explored the rejection of one pole of this opposition, determinism (in the sense of progress towards the evolution of intelligent life), in *Galápagos* and *Wonderful Life*. Both books deny that the emergence of intelligence was inevitable once evolution got going: humans are not the *telos* of natural history. In order to see how Gould and Vonnegut avoid accepting the opposite pole, complete chance, instead, we need to explore the ways in which they present the mechanisms of natural selection.

For Gould, the reigning, determining factor in evolution is contingency. We can see why this is stressed by considering the general argument put forward in his book. *Wonderful Life* is concerned with the Burgess Shale in British Columbia, an important fossil locality discovered by Charles Doolittle Walcott in 1909. Gould describes how Walcott's original analysis of the Burgess Shale fossils placed all of the organisms into existing, known categories of fauna, 'viewing the fauna collectively as a set of primitive or ancestral versions of later, improved forms.'¹⁷ The assumption with which Walcott approached the evidence was that 'fossils fall into a limited number of large and well-known groups, and that life's history generally moves toward increasing

¹⁶Gould, *Wonderful Life* 50.

¹⁷Gould, *Wonderful Life* 24.

complexity and diversity.’¹⁸ In other words, it was an assumption that there is a definite progress underpinning the history of life on earth: a small number of species-groups, early on in evolution, would inevitably give rise to a larger number of more complex forms later on.

What *Wonderful Life* charts is the process by which the revision of this viewpoint can be seen in the reinterpretation of the Burgess Shale fossils. Rather than assume that the Burgess fossils represent a large number of fauna belonging to a few, well-known groups, the new approach to the Shale suggests that the fossils in fact represent many groups, a lot of which have now become extinct. In other words, evolution has not been a process of steady diversification and increasing complexity of life-forms, but has involved the mass-extinction of many groups of organisms. Furthermore, Gould suggests, it is not possible to say, from the evidence we have, which organisms were best fitted to survive into the future. There seems to have been a large element of luck involved.

This is where contingency comes in, because Gould does not mean that luck should be understood, in this case, to refer to complete chance. There are reasons for what happens - it is just that these reasons cannot be understood in terms of a steady, unchanging sequence of factors that would allow us to divine what is going to happen in advance. Rather than direct control, by timeless rules of physics which would always produce the same evolutionary result (progress towards intelligent life), Gould suggests that the particular pathways that evolution takes are a response to a multitude of local, individual conditions. In other words, history is admitted into science as a valid explanatory form. This offers another option, favoured by Gould, to the otherwise rigid alternatives of either progress or ‘coin tossing’ which I referred to above:

This third alternative represents no more nor less than the essence of history. Its name is contingency - and contingency is a thing unto itself, not the titration of determinism by randomness. Science has been slow to admit that different explanatory world of history into its domain. . . . Science has also tended to denigrate history, when forced to a confrontation, by regarding any invocation of contingency as less elegant or meaningful than explanations based directly on timeless ‘laws of nature.’¹⁹

¹⁸Gould, *Wonderful Life* 111.

¹⁹Gould, *Wonderful Life* 51. Quotations like this inevitably recall similar statements which are associated with chaos theory - both sciences seem to be partaking of a postmodern discourse through these sorts of insights.

The implication of this is brought out most dramatically in a thought experiment that Gould proposes, in which we are asked to imagine the history of life on earth as a tape recording. If we rewind the tape to the beginning and let history run again, what will happen? According to Gould, we will not see evolution repeat itself. Instead a whole new natural history will emerge: 'a replay of life's tape would yield a substantially different set of surviving anatomies and a later history making perfect sense in its own terms but markedly different from the one we know.'²⁰

Interestingly, these new interpretations of the Burgess Shale, which ran counter to Walcott's initial classification of the fossils, did not involve the discovery of any new evidence, but the rereading of existing evidence. This suggests that a new intellectual climate facilitated the new understanding. This climate shares definite characteristics with shifts to a postmodern phase in other areas of the core literature/science discourse.

Gould himself is amenable, without resorting to relativism, to the idea that an intellectual climate can shape scientific opinion. For instance, he suggests that Darwin was influenced by Victorian notions of progress: 'Progress was the watchword of his surrounding culture, and Darwin could not abjure such a central and attractive notion. Hence, in the midst of tweaking conventional comfort with his radical view of change as local adjustment, Darwin also expressed his acceptance of progress as a theme in life's overall history.'²¹ It is with this viewpoint that Walcott's initial interpretation of the Burgess Shale accorded.

Gould hints that the revision of Walcott's view also responds to a particular intellectual climate. For instance, he speculates about what prompted Professor Henry Whittington, who promoted new interpretations of the Burgess Shale with a monograph in 1971, to propose a different viewpoint to that of Walcott:

We have a reasonably well-controlled psychological experiment here. The data had not changed, so the reversal of opinion can only record a revised presupposition about the most likely status of Burgess organisms. Obviously, Whittington had come to accept, and even to prefer, the idea of taxonomic uniqueness for animals of the Burgess Shale.²²

Whatever the reason for these new interpretations, we are being presented with a view of change over time that is very different to one in which straightforward

²⁰Gould, *Wonderful Life* 304. The current patterning of life is determined, in Gould's view, by periods of mass extinction when survival is either random, or dependent on different rules than prevail under normal conditions. For a longer description of the thought-experiment described here, see Gould, *Wonderful Life* 48-50.

²¹Gould, *Wonderful Life* 257-58.

²²Gould, *Wonderful Life* 172.

progress towards a goal provides the core evolutionary drive. Teleology is all but absent from this view of life although it does persist, in a greatly denuded form, as short-term adaptation to local environmental conditions. In the long term, present life forms record 'the few fortunate survivors in a lottery of decimation, rather than the end result of progressive diversification by adaptive improvement. . . .'²³ The future is not an improvement upon the past then; it is just different to it. We can see this, and Gould's view of contingency, mirrored in *Galápagos*.

Gould focuses on periods of mass extinction, but Vonnegut deals with a calamity which affects just one species, the human race, which is all but wiped out by a bacterium which eats human eggs. The question we need to ask in order to understand whether or not Vonnegut's view of evolution accords with that of Gould is, what determines human survival into the future? What factors lead to the continued existence of human life on the island of Santa Rosalia and shape the form which that life eventually takes?

Intelligence is certainly not a factor. I have already shown how Vonnegut mocks the effects of the human brain upon the species' prospects for survival, and throughout the novel he focuses on the absurdities of human behaviour to suggest that we are anything but the rational creatures we like to imagine ourselves to be.

What does determine human survival in the novel is a series of accidents, and it is through these that Vonnegut admits a view of evolution which is akin to the contingency invoked by Gould. The history of the Galápagos islands, South America, and the individuals involved is constantly referred to as a sequence of lucky chances by Vonnegut. We are told that the islands were discovered when a ship was blown off course in 1535,²⁴ and that their transformation by Darwin into something worthwhile was 'magical.'²⁵ This led to the tourist boom on the islands and, ultimately, to the 'Nature Cruise of the Century,' which brings the future ancestors of all humanity to Guayaquil in Ecuador.

These people only come on the cruise because of another series of accidents. For instance, Mary's husband Roy only signs up because a brain tumour affects his ability to reason clearly,²⁶ and Mary herself can only go, after his death, because she loses her teaching job²⁷ - yet her presence on Santa Rosalia is crucial because her crude

²³Gould, *Wonderful Life* 304.

²⁴Vonnegut, *Galápagos* 23.

²⁵Vonnegut, *Galápagos* 24.

²⁶Vonnegut, *Galápagos* 34-35.

²⁷Vonnegut, *Galápagos* 39.

experiments in artificial insemination produce the first generation of children on the island.

The six girls of the Kanka-bonos tribe, who are going to be 'mothers of all humankind',²⁸ reach Guayaquil and the boat, the *Bahía de Darwin*, by an even more tortuous route.²⁹ They avoid being wiped out by insecticides sprayed from a plane, like the rest of their tribe, because they are in choir practice with a missionary, Father Fitzgerald. A bush pilot, Eduardo Ximenez, only takes them to Guayaquil because he happens to see an S.O.S. stamped in the mud by Father Fitzgerald and the girls. Once there, the only speaker of their language, Domingo Quezada, puts them into a life of crime as street children. After escaping him, they happen to be in the right place to take advantage, unknowingly, of a route opened up when a building is broken into by Geraldo Delgado, a soldier acting under the influence of paranoid schizophrenic delusions. As a result they fortuitously board a bus carrying some other passengers who will prove to be important in evolutionary terms. The bus ends up at the *Bahía de Darwin* only because it follows the 'path of least resistance' through the rubble of the city (which has just been subjected to rioting, and an airborne attack by Peru).³⁰ This path happens to lead to the waterfront. When the boat casts off, and disappears, no-one looks for it because one of the Peruvian fighter pilots mistakes a boat which he has destroyed for the *Bahía de Darwin*.³¹ The Captain, Adolf von Kleist, ancestor to all future humans, is merely a figurehead and therefore unable to sail the ship. Consequently he runs it aground on Santa Rosalia by accident. In the light of this, the decision of Hernando Cruz, the first mate and an able seaman, to desert the ship, is crucial to the survival of humanity: 'For want of Hernando Cruz aboard the *Bahía de Darwin*, humanity was saved. Cruz would never have run the ship aground on Santa Rosalia.'³²

What Vonnegut emphasises then, throughout these episodes, and many others which I have not mentioned, is the chance survival of humanity. None of the characters consciously act to reach Santa Rosalia, and even their short-term survival is due to luck, rather than physical prowess, intelligence, or ingenuity. However, this embraces Gould's vision of contingency rather than pure chance, because determinism acts through the chance incidents that shape the characters' lives. Outside forces shape

²⁸Vonnegut, *Galápagos* 140.

²⁹Vonnegut, *Galápagos* 140-46.

³⁰Vonnegut, *Galápagos* 182.

³¹Vonnegut, *Galápagos* 194.

³²Vonnegut, *Galápagos* 132.

what happens to them - determine their lives - but there is no over-riding purpose which moulds these forces. They are not expressions of a drive towards anything; they just happen. Once the ancestors of all future humans have improbably, and fortuitously, reached Santa Rosalia, however, a more predictable sort of determinism reasserts itself. This is because the eventual evolution of humans into fishing creatures is almost certain given the local, contingent conditions which prevail on the island:

But in the long run, I don't think it would have made much difference which males did the impregnating, Mick Jagger or Dr Henry Kissinger or the Captain or the cabin boy. Humanity would still be pretty much what it is today.

In the long run, the survivors would still have been not the most ferocious strugglers but the most efficient fisherfolk. That's how things work in the islands here.³³

So Vonnegut's presentation of evolution is remarkably similar to Gould's. During unusual periods, when a new and serious threat troubles the species, and for which it cannot possibly have evolved, chance events determine who survives and what evolutionary conditions they will face in the future. After that, we return to a more normal period when the evolutionary pressure is constant, and the direction of evolution is therefore more readily determined by predictable factors. In the long run, though, contingency rules.

What this embrace of contingency, and rejection of progress, involves, in both *Galápagos* and *Wonderful Life*, is an erosion of the concept of teleology. Without progress, there can be no journey towards a goal; with contingency, any shaping factor in evolution will not have a long-term effect because chance events will throw the course of evolution onto a different path.

Is there *any* purpose which we can find to the history of life? Certainly not in terms of a human-centred teleology. Progress towards intelligence, or anything else which we might use to distinguish humans from the rest of the natural world, is rejected as a driving force in evolution by both Gould and Vonnegut. If there is a purpose it is only that of persistence, and if there is a goal it is only that of survival. Gould's proposal that contingency is so important perhaps makes the achievement of this goal rather haphazard and short-term; with changing conditions determining survival, there is no telling what form of life will be best suited to persist into the future. Indeed, a form which favours continued existence at one time, may mitigate against it at another time. Nevertheless, it is a form of purpose.

³³Vonnegut, *Galápagos* 167.

It is not so different from the only sense of purpose which Dawkins allows us in his descriptions of evolution: short-term adaptation, with no long-term view. Those genes which happen to favour survival at one time will be those genes which happen to persist into the future. In the face of a world shaped by these sorts of short-term evolutionary trends, both science writers find fascination, not purpose, in the history of life, and celebrate a kind of existentialist freedom to appreciate the world in all its indifferent complexity. For instance, Gould ends his book with the following observation:

The survival of *Pikaia* [oldest ancestor of humans] was a contingency of 'just history.' I do not think that any 'higher' answer can be given, and I cannot imagine that any resolution could be more fascinating. We are the offspring of history, and must establish our own paths in this most diverse and interesting of conceivable universes - one indifferent to our suffering, and therefore offering us maximal freedom to thrive, or to fail, in our own chosen way.³⁴

What Gould is suggesting here, is that we cannot look for meaning in nature; we can only find it within ourselves. A human-centred meaning to life is not going to be a meaning which has a reality outside of a human frame of reference.

Whether this is the renunciation of a mastery of nature which White identifies in postmodern versions of evolution is another matter. White seems to imply that any attempt to rationalise the workings of nature implies a symbolic mastery of it. It is difficult to see how *any* narratives of evolution accord with a rejection of this sort of mastery, for Gould, and others like him, are as determined to understand nature as anyone else - we do get a very real sense of what White calls the 'consolation of intelligibility' from *Wonderful Life*.³⁵ This is, however, a minor quibble, and White's larger point, about the move from modern romance to a presentation of evolution as a sort of 'postmodern picaresque,' stands untouched.

Gould's work does seem to accord with this view. The knowledge that there is no overall purpose to life - except to keep on living - leads him to suggest that we must find a purpose within ourselves. It is precisely this dilemma, about human purpose in an indifferent universe, that Vonnegut uses evolution to explore in *Galápagos*. He too acknowledges that if evolution is not about progress, but mere survival, then there is a real problem with ascribing meaning to the world. Purpose, for all the species that are described in the novel, is merely self-perpetuation, and they are not even conscious that this is their purpose. This comes across most strongly in Vonnegut's descriptions of

³⁴Gould, *Wonderful Life* 323.

³⁵White, 'End of Metanarratives' 69.

the courtship dance of the blue-footed boobies, a species of bird which populates Santa Rosalia. The elaborate ritual which they go through, Vonnegut suggests, is just part of how they are determined, and how they go about getting a mate - we cannot ascribe any artistic expression or freedom to the dance: 'As for the meaning of the courtship dance of the blue-footed boobies: The birds are huge molecules with bright blue feet that have no choice in the matter. By their very nature, they have to dance exactly like that.'³⁶ Like the evolution of life, the courtship dance begs an explanation, but any human-centred interpretation that desires to find a higher meaning in it, is going to be wrong. Blue-footed boobies do what blue-footed boobies do - they are 'molecules' that have to behave in a certain way. There is no higher purpose to their lives.

The importance of this dance to Vonnegut's wider discussions of purpose and teleology in evolution is made explicit elsewhere. Mary asks her students to write a poem or an essay about the courtship dance, and her favourite response come from Noble Claggett:

Of course I love you,
So let's have a kid
Who will say exactly
What its parents did;
'Of course I love you,
So lets have a kid
.....'
Et cetera.³⁷

The purpose of the dance is purely to mate, and have offspring which will also dance and, in their turn, mate to produce further offspring. Trout tells us, from his position far in the future, that the dance 'has not changed one iota in a million years.'³⁸ The birds dance solely because they are ancestors of birds who dance.

Whether perpetuation of the species is also the sole purpose of human life, is a question which Vonnegut explores in the novel, and to which he produces an ambiguous response. This comes out in a paragraph that follows his description of the blue-footed boobies as molecules forced to do a dance: 'Human beings used to be molecules which could do many, many different sorts of dances, or decline to dance at all - as they pleased.'³⁹ His description of humans as 'molecules' suggests a machine-like quality which accords with issues raised in my exploration of the human/machine

³⁶Vonnegut, *Galápagos* 102.

³⁷Vonnegut, *Galápagos* 100.

³⁸Vonnegut, *Galápagos* 102.

³⁹Vonnegut, *Galápagos* 102.

dichotomy in the last chapter: humans are machines that do what humans are programmed to do. However, the suggestion that they can choose to do different dances is more ambiguous - does this mean that they do have freedom, or does it just mean that the restriction on their freedom is more carefully hidden?

This dilemma about whether humans have a higher purpose, or whether they are at the mercy of their role in meaningless cycles of reproduction, comes out in Leon Trout's description of his ancestry, with his inheritance from his mother suggesting that there is a meaning to life, and his inheritance from his father suggesting that life's only purpose is to keep life going. His mother proudly tells him that he is descended, on her side, from French noblemen. However his cynical father, Kilgore, responds in a very different way to Leon's question about whether there is noble blood on his side of the family: 'I didn't know then what sperm was, and so wouldn't understand his answer for several years. "My boy," he said, "you are descended from a long line of determined, resourceful, microscopic tadpoles - champions every one."'”⁴⁰

Leon's mother reveals a conventional conviction that noble blood can determine status, and implies that there is a purpose in evolving ancestries. His father reveals the possibility of an almost purposeless world - all there is to be proud of in the progression of the family through the generations is that each one was able to reproduce. This celebration of 'champion tadpoles' is reminiscent of Dawkins' insistence at the beginning of *River Out of Eden*, in a passage dealing with ancestry, that the only purpose of life is to keep living: 'All organisms that have ever lived . . . can look back at their ancestors and make the following proud claim: Not a single one of our ancestors died in infancy. They all reached adulthood, and every single one was capable of finding at least one heterosexual partner and of successfully copulating.'⁴¹

The eventual evolution of humans into seal-like creatures whose only purpose is to fish and survive long enough to reproduce, suggests that Vonnegut sees the purpose of humanity purely in terms of persistence as well; that he sides with Leon's father rather than his mother. However, there are one or two suggestions in the novel that Vonnegut is not stating this as the truth of the matter, but just playing with the possibility that this is the truth. Vonnegut forces us to face the dreadful possibility that human life is meaningless, but does not confirm that this is the case.

Leon Trout's continuing fascination with humans - and his refusal to go into the afterlife until he has seen what happens to them - suggests that there was something meaningful and interesting about humans in the era of big brains, even though we cannot find meaning in evolution itself. A million years in the future - when all they do

⁴⁰Vonnegut, *Galápagos* 144.

⁴¹Dawkins, *River* 1.

is fish - Trout expresses a sense of loss. Even though his narration has, for the most part, presented the evolution of humans into fisherfolk as a process of the species being forced to accept its humble status among the other creatures of the earth, there is a sense in which big-brained humans brought something interesting to the planet:

I can expect to see the blue tunnel [to the afterlife] again at any time. I will of course skip into its mouth most gladly. Nothing ever happens around here any more that I haven't seen or heard so many times before. Nobody, surely, is going to write Beethoven's Ninth Symphony - or tell a lie, or start a Third World War.

Mother was right: even in the darkest times, there really was still hope for humankind.⁴²

'Hope,' here, might mean hope that, despite wars and deceit, great music could be produced by humans; or it might merely mean that there was always the hope that humans might be able to evolve away from their big-brained, cataclysmic successes and failures.

This dialogue between purpose and lack of purpose, and progress and mere change, is what Vonnegut uses evolution to explore in *Galápagos*. Although there is a direct link to contemporary presentations of evolution in the novel, the same themes have their roots much earlier in Vonnegut's work. In order to demonstrate that equivalent views of time arose separately in literature and science, before Vonnegut made the explicit link between the two in *Galápagos*, I will now explore his development of the idea by working my way through the relevant novels in chronological order.

The Development of a Postmodern View of Time in the Novels of Kurt Vonnegut

(i) Machines Against Humans: *Player Piano*

Although this early novel does not dwell upon time as one of its themes, by dealing with a conflict between humans and machines it marks Vonnegut's concern, at the beginning of his career as a writer, with issues which were to develop into the explicit treatment of evolution that he produces in *Galápagos*. This is because the human versus machine conflict is also a conflict between free will and determinism. This has obvious consequences for how we view change over time - if we have free

⁴²Vonnegut, *Galápagos* 236. Perhaps Trout's fascination with humans mirrors Gould's and Dawkins' fascination with life in general.

will, then the future is not set, but if we are part of a machine-like universe then the future is unalterable.

Vonnegut imagines a society with a three-fold structure, which is given geographical expression in the splitting of Ilium, where the action takes place, into three sectors: the south, Homestead, for the menial workers and those displaced by society; the northwest for the managers, engineers, civil servants, and professional people; and the northeast for the machines which run the country. This strict physical segregation of Ilium provides the template upon which a rigid social order is constructed, with the machines determining the lives of individuals, and regulating the type of work that they do.

The novel deals with an uprising against this rigid social stratification, and the allied mechanisation, of the country. In charting the failure of this revolution, it expresses a despair with the ideal of a society where machines have a limited, useful role, simultaneously allowing for individuality, and self-expression among the citizenry. This is made apparent by the three counts on which the revolution fails in the eyes of Paul Proteus, one of the revolutionaries: it is crushed by the security forces but, more importantly, rioters smash useful as well as useless machines, and people's curiosity drives them to start trying to remake machines from the wreckage of those that have been destroyed.

The novel actually bemoans the lack of a middle ground between the possibilities of a machine society and a non-machine society, mourning the existence of a stark binary choice between determinism and free-will. People will either smash everything, or they will thoughtlessly reconstruct the machines. With the failure of the revolution, society will revert to its wholly mechanised form, with the individual's role in life determined purely by his or her performance in tests at a young age. The choice, as Proteus comes to see it, is between an overly mechanised society, where the machines determine everything that people do, and complete anarchy - either the needs of the individual are wholly subordinated to those of society, or there ceases to be anything approximating a society because individual actions are in no way curtailed by the needs of other members of the community.

The centrality of this notion to the novel is made clear by the references to the 'player piano' of the title. A player piano is one which plays a pre-programmed tune, depressing its keys automatically. The tune is therefore machine-determined, rather like the meaningless dance of the blue-footed boobies, the 'molecules' of *Galápagos*, who go through their absurd motions again and again over millions of years. Vonnegut's novel offers an alternative to these pre-set tunes, but it is one which is a renunciation of any ordered musical form: Ed Finnerty, one of the revolutionaries, over-rides the

mechanism that controls the piano, playing his own 'hellish' music instead.⁴³ The options, in this symbolic gesture, are between determinism (automatic music) and anarchy (Finnerty's 'hellish' music). Vonnegut's adoption of the player piano as a guiding motif for the novel, introduces a theme which is of importance throughout his career, and which is allied to the human/machine one: the role of art in an indifferent universe.

What we have here then are the seeds of the dilemmas about time which Vonnegut explores in *Galápagos*: are things determined, or is there room for free-will to shape the course of history? These ideas find more complex expression in *Sirens of Titan*, the next novel in the sequence I am considering. If *Player Piano* bemoans the lack of a middle ground in the conflict between determinism and free-will, *Sirens of Titan* develops this idea by making the determinism it treats a universal condition, rather than something isolated within a particular society. It also introduces distortions of chronological time as a central motif of the novel.

(ii) Human Purpose in a Machine Universe: *Sirens of Titan*

The extent to which our lives are determined by outside forces is again explored in *Sirens of Titan*. Our first introduction to this theme is through Malachi Constant, the luckiest man on earth, who inherits from his father a method for amassing a vast fortune from an irrational and wholly fortuitous scheme of investments, based on matching biblical text with the initials of companies. Although he considers himself to be free, he finds out that he is under the control of Niles Rumfoord.

Rumfoord's control of Malachi, and of human life in general, is one of two main plot strands through which determinism is explored in the novel. Along with his dog Kazak, Rumfoord gets caught in a chrono-synclastic-infundibula (the ridiculous name indicates the humour with which Vonnegut treats the scientific ideas he invents - the science he presents in his science fiction is wholly fantastical). This leaves him existing in the form of waves that flow across the solar system, materialising on different planets at different times, and on Titan, a moon of Saturn, continually. It also allows Rumfoord to see into the past and the future. Given the possibility of manipulating events, and being able to see the consequences of this manipulation, he decides to improve life on earth.

He does this by kidnapping people, brainwashing them, and forming them into a fanatical but utterly ill-equipped Martian army to attack earth. Earthlings are forced to wipe them out and, overcome with guilt, they renounce violence, and any form of

⁴³Kurt Vonnegut, *Player Piano* (New York: Delacorte, 1952) 91.

divine authority, believing only in a god who is supremely indifferent - there is no purpose to life. Malachi Constant features because he is also kidnapped by Rumfoord, and is later offered to earthlings as proof that, if there is a creator, he is wholly indifferent to them.

It is here that we get a treading of the middle ground between determinism and chance, and a view of change over time which is recognisably similar to that proposed in *Galápagos*. Events are determined by an outside force, but they have no meaning. The religion that results from Rumfoord's interventions illustrates this - and also presages the central tenets of Bokonism, a religion that Vonnegut creates in *Cat's Cradle*. In order to impress the efficacy of his artificial religion upon earthlings, Rumfoord prophesies Malachi's exact actions and words when he arrives back on earth. Bewildered by the enthusiastic welcome he receives, Malachi (or Unk, as he is now known) finds himself acting exactly in the way that the earthlings have been led to expect by Rumfoord's predictions:

[Unk] could think of no apt condensation of his adventures for the obviously ritual mood. Something great was plainly expected of him. He was not up to greatness. He exhaled noisily, letting the congregation know that he was sorry to fail them with his colourlessness. 'I was a victim of a series of accidents,' he said. He shrugged. 'As are we all,' he said.

The cheering and dancing began again.⁴⁴

The impression that we are all victims of a series of accidents - that we are determined by what happens to us, but that there is no purpose to this - is very similar to the history of the human race as it appears in *Galápagos*, where the characters are also victims of a series of accidents.

However, at this point it is not quite like *Galápagos*. Although people are victims of accidents, there is at least some meaning to the ways in which their lives are being manipulated, albeit only Rumfoord's attempts to make life more pleasant. The second major plot strand removes even this sense of meaning though. This is because it reveals that Rumfoord himself has also been manipulated and controlled, and there is no human-centred purpose to this determination of his life. He, and in fact all of human history, have been manipulated in order to convey messages to Salo, a Tralfamadorian who is stranded by his faulty spaceship on Titan, a moon of Saturn. Events in earth's history, and Rumfoord's life, convey messages to him from Tralfamadore. The Great Wall of China, for instance, is really just a message meaning

⁴⁴Kurt Vonnegut, *The Sirens of Titan* (1959; London: VGSF-Gollancz, 1989) 161.

'[r]eplacement part being rushed with all possible speed,' and the Moscow Kremlin means, '[y]ou will be on your way before you know it.'⁴⁵

Nor is there any higher purpose to these forces that manipulate human life. Salo is on a mission to celebrate the anniversary of the Tralfamadorian civilisation, by conveying a message from Tralfamadore to the most far-flung alien culture he can reach. Yet, grand though this seems, when he opens the message against orders, and at Rumfoord's insistence, he finds that it is essentially meaningless because it simply says, '*Greetings*.'⁴⁶

So we have a sense of the universe as a purposeless machine here. Just as humans go through a crisis concerning the reason for their existence in the novel, so we find that the Tralfamadorians too, have faced such a crisis in their history. Obsessed with the idea that everything had to have a purpose, and that some things had a higher purpose than others, creatures on Tralfamadore committed themselves to finding and understanding the higher purpose. Each time they discovered what it was, it seemed so low that they felt disgusted and ashamed and, rather than serve it, they created machines to serve it, while they themselves looked for a still higher purpose. This carried on until the machines were asked to find out what the purpose of the creatures themselves was:

The machines reported in all honesty that the creatures couldn't really be said to have any purpose at all.

The creatures thereupon began slaying each other, because they hated purposeless things above all else.

And they discovered that they weren't even very good at slaying. So they turned that job over to the machines, too. And the machines finished up the job in less time than it takes to say 'Tralfamadore'.⁴⁷

As a result Salo, and all the other Tralfamadorians, are nothing more than machines, appropriate life-forms for a meaningless machine-like universe. This also ties in, of course, with the issues raised by the subversion of the human/machine dichotomy which I explored in chapter six. *Cat's Cradle* pushes further the notion that events are both determined and meaningless.

⁴⁵Vonnegut, *Sirens* 190.

⁴⁶Vonnegut, *Sirens* 210.

⁴⁷Vonnegut, *Sirens* 192-93. Vonnegut's italics.

(iii) Inventing a Purpose to Explain the Machine: *Cat's Cradle*

Bokonism, the fictional religion that Vonnegut creates in *Cat's Cradle*, is similar in many ways to Rumfoord's religion in *Sirens of Titan*. The central notion of Bokonism, that we are placed where we are by outside forces, is emphasised even before the religion is mentioned, with John Hoosier's introduction of himself as the narrator:

Jonah - John - if I had been a Sam, I would have been a Jonah still - not because I have been unlucky for others, but because somebody or something has compelled me to be certain places at certain times, without fail. Conveyances and motives, both conventional and bizarre, have been provided. And, according to plan, at each appointed second, at each appointed place this Jonah was there.⁴⁸

Bokonism too, emphasises this sense of being placed and determined by the complexities of life: '*Busy, busy, busy*, is what we Bokonists whisper whenever we think of how complicated and unpredictable the machinery of life really is.'⁴⁹

The idea of a 'machinery' of life emphasises determinism, but the purpose of this machinery is always concealed by complexity and, therefore, unpredictability. For instance, as early as the second chapter, we are told that Bokonism preaches the unknowability of life. One of the many terms which Vonnegut coins for his religion, *karass*, means the team of people who are connected to an individual and affect his or her life. There is no hope, however, of finding out how the *karass* operates: 'Nowhere does Bokonon warn against a person's trying to discover the limits of his *karass* and the nature of the work God Almighty has had it do. Bokonon simply observes that such investigations are bound to be incomplete.'⁵⁰

In the face of this unknowability, Bokonists passively accept that things are bound to happen, writing off events in their lives with the phrase 'as it was *supposed* to happen,'⁵¹ rather than 'as it happened.' In the face of this overwhelming drive, there seems to be little that individuals can do to shape their own lives, and the religion seems to countenance the passive acceptance of this state of affairs.

Yet the explanation that is offered for life - the purpose that lies behind it - is much the same in Bokonism as it is in Rumfoord's artificial religion in *Sirens of Titan*. Although it invokes God, Bokonism does not really hold out the possibility that a

⁴⁸Kurt Vonnegut, *Cat's Cradle* (1963; London: Gollancz, 1974) 13.

⁴⁹Vonnegut, *Cat's Cradle* 61.

⁵⁰Vonnegut, *Cat's Cradle* 15.

⁵¹Vonnegut, *Cat's Cradle* 76, 77, 191.

divine force shapes events. This is because it undercuts itself by admitting that it is nothing but lies. For instance, when asked if he is a Bokonist, Dr. von Koenigswald says, 'I agree with one Bokonist idea. I agree that all religions, including Bokonism, are nothing but lies.'⁵² Even the title page of *The First Book of Bokonon* has a warning on it: 'Don't be a fool! Close this book at once! It is nothing but *foma!* [lies]'⁵³ This leads us to the 'cruel paradox of Bokonist thought, the heartbreaking necessity of lying about reality, and the heartbreaking impossibility of lying about it.'⁵⁴

This takes us a stage further than *Sirens of Titan* in our explorations of purposelessness, because Vonnegut uses Bokonism to explore more directly the systems of interpretation that we have to invent in order to make sense of a meaningless universe. Our descriptions of it are always going to be inadequate, are always going to be lies, and yet they will also always have some sort of 'truth' about them, because they will be more accurate than a complete refusal to articulate the world. Bokonism presents things 'as they are,' yet the explanations it offers inevitably lack, like Rumfoord's artificial religion in *The Sirens of Titan*, the ability to find any purpose to life.

This lack of purpose suggests that individual actions are meaningless when set against the huge framework of events that constitute history. As in many of Vonnegut's novels we are presented with a huge force which cannot be stopped, and which overwhelms individual lives. In *Cat's Cradle* this is 'ice-nine,' a substance which, once it comes into contact with water, will turn it into ice. However, although ice-nine eventually destroys the world, Vonnegut does offer a glimmer of hope that individual actions may have value on a local scale. For instance, after it is used for one of the first times, Newt, Angela, Frank and the narrator work to rectify the trouble that ice-nine has caused: 'In a messy world we were at least making our little corner clean.'⁵⁵ Although this is a futile as well as a hopeful action, it does at least signal defiance in the face of the inexorable march of events.

Similar small gestures of defiance occur in *Sirens of Titan* and *Galápagos*. The former ends with Salo depositing the dying Malachi Constant back on earth. Before he goes, Salo hypnotises him 'so that he would imagine, as he died, that he saw his best and only friend, Stony Stevenson.'⁵⁶ In the latter, Captain von Kleist tries to put his

⁵²Vonnegut, *Cat's Cradle* 179.

⁵³Vonnegut, *Cat's Cradle* 214.

⁵⁴Vonnegut, *Cat's Cradle* 229.

⁵⁵Vonnegut, *Cat's Cradle* 200.

⁵⁶Vonnegut, *Sirens* 223.

ship in order after an orgy of looting has stripped it: 'The shower in the head was dripping, and he turned it off right. That much he could make right, anyway.'⁵⁷ These are gestures of kindness and hope in a universe that is indifferent to the human plight. The questioning of the value of these individual, small-scale actions, in the face of the huge historical events which overwhelm them, is the central theme of *Slaughterhouse-Five*. As we shall see, Vonnegut focuses not so much on writing an anti-war novel, as on the impossibility of writing an anti-war novel. Yet, at the same time he expresses dissatisfaction with absolute resignation in the face of the large-scale forces which shape our lives. Again, in *Slaughterhouse-Five*, there is a sense of small-scale actions having some value: 'I have told my sons that they are not under any circumstances to take part in massacres, and that the news of massacres of enemies is not to fill them with satisfaction or glee.'⁵⁸

Cat's Cradle also anticipates *Slaughterhouse-Five* by making form intrinsic to content in a way which was not apparent in the earlier novels. The simplistic style of writing is crucial to the themes that Vonnegut is attempting to explore, expressing the difficulty of rendering the world adequately. This is perhaps what was meant in the assertion that the central paradox of Bokanism is that it is impossible to tell the truth about reality, and it is impossible to lie about it. What can be said about reality can be stated in bald, bland sentences, much as, at the beginning of *Slaughterhouse-Five*, Vonnegut says everything he wants to about the nastiness of massacres in a few words which, because they are so simple, fail to convey the full reality of the Dresden bombing. In *Cat's Cradle* we are presented with a narrator who uses a lot of very simple sentence constructions. After most humans have been wiped out by ice-nine, there is nothing the characters can say which will adequately express the scale of the devastation, and their lives shrink into irrelevance beside it. Faced with events that are beyond expression, they too fall back on a series of clichés: 'Don't shoot the cook. He's doing the best he can'; "'Save our soulslllls," Hazel intoned, singing along with the transmitter'; 'You'll be one of a long, long line'; 'I like a good laugh'; 'Each person here has some speciality, something to give the rest'; 'Many hands make much work light'; 'let's keep their memory alive'; 'No use crying over spilt milk.'⁵⁹

So, while *Cat's Cradle* recalls the sense of a world ruled by purposeless determinism that we found in Vonnegut's earlier novels, it also develops these ideas by using Bokanism to explore humans' need to re-imagine reality, in order to make sense

⁵⁷Vonnegut, *Galápagos* 177.

⁵⁸Kurt Vonnegut, *Slaughterhouse-Five: Or, The Children's Crusade: A Duty-Dance with Death*, (1969; London: Vintage, 1989) 14.

⁵⁹Vonnegut, *Cat's Cradle* 224-25.

of it, and by making all of these ideas intrinsic to the novel's form. This relationship between language and reality finds expression in the references to cat's cradles in the book. For instance:

Newt remained curled in the chair. He held out his painty hands as though a cat's cradle were strung between them. 'No wonder kids grow up crazy. A cat's cradle is nothing but a bunch of X's between somebody's hands, and little kids look and look and look at all those X's. . . '

'And?'

'No damn cat, and no damn cradle.'⁶⁰

Any expression of reality has to be a transformation of it, and therefore a fiction. This is tied up with the purposelessness of life, summed up in the childlike rhymes of the Bokonist song which recalls Noble Claggett's poem about the dance of the blue-footed boobies in *Galápagos*:

We do, doodley do, doodley do, doodley do,
What we must, muddily must, muddily must, muddily must;
Muddily do, muddily do, muddily do, muddily do,
Until we bust, bodily bust, bodily bust, bodily bust.⁶¹

We are beings who do what we must till we bust, just as, in *Galápagos*, creatures live and reproduce purely to create other creatures that will, in turn, live and reproduce. *Slaughterhouse-Five* develops these ideas about purpose, free-will and determinism, by making time and time-travel into central features of the plot.

(iv) Finding the Middle Ground Between Free Will and Determinism: *Slaughterhouse-Five*

How can we summarise the development of the theme of time in Vonnegut's work so far? In *Player Piano* time was not a central theme at all. However, other themes in the novel dealt with ideas that were later to become important to the presentation of time that eventually appears in *Galápagos*. Most important of these were the conflicts between free will and determinism, and humans and machines.

Sirens of Titan took these two ideas and made time itself more central to them, even introducing time travel, of a sort, as a plot device. It is in this novel that we first get a representation of time which is recognisably similar to that which is married to the presentation of evolution in *Galápagos*: human life is manipulated by outside agencies,

⁶⁰Vonnegut, *Cat's Cradle* 137. Vonnegut's ellipsis.

⁶¹Vonnegut, *Cat's Cradle* 216.

but for no grand purpose. Although *Cat's Cradle*, the next novel, drops time travel as a plot device, it also proposes a sense of human lives being manipulated by indifferent outside forces. Although we are warned that the novel is not a tract promoting Bokonism, this fictional religion serves to express a sense in which there is determinism, but not purpose, in the world. *Cat's Cradle* also makes form more central to the exploration of these ideas, the simplistic style in which the first-person narration proceeds, serving to express the difficulties the central character has in articulating the sheer scale of what has happened to the world.

Slaughterhouse-Five reinstates time travel as a central feature of the novel, and also develops the use of form to explore the free will/determinism and organism/machine boundaries. Tralfamadorians again feature as an alien life form, and although it is not obvious whether they are the same machines as appeared in *Cat's Cradle*, they certainly represent a view of the universe which is machine-like. Their ability to see in four dimensions - time as well as space - allows them to educate Billy during the rather pleasant kidnapping that they arrange for him, and they teach him the view, that we have already found in Vonnegut's earlier novels, that things are determined but to no real purpose.

This comes out explicitly in their response to Billy's question about why they have kidnapped him rather than someone else: 'That is a very *Earthling* question to ask, Mr. Pilgrim. Why *you*? Why *us* for that matter? Why *anything*? Because this moment simply *is*. Have you ever seen bugs trapped in amber? . . . Well, here we are, Mr. Pilgrim, trapped in the amber of this moment. There is no *why*.'⁶² This suggests that our explanations of why things change over time are meaningless - or, at least, highly problematic. The difficulty of expressing this lack of any meaning is brought out by the use of italics in the above passage - there is nothing to say beyond a blank statement that things are as they are. Yet this fact that there is nothing meaningful to say is itself very important and has to be emphasised through the use of italics: the moment *is*, there is no *why*.

This does not only express a belief about the universe. It also necessarily suggests a way of acting (or rather, as we shall see, not acting) in the universe. Again, the Tralfamadorians explain this to Billy: 'All time is all time. It does not change. It does not lend itself to warnings or explanations. It simply *is*. Take it moment by moment, and you will find that we are all, as I've said before, bugs in amber.'⁶³

⁶²Vonnegut, *Slaughterhouse-Five* 55. Vonnegut's hope that the Tralfamadorians are wrong in this, is neatly expressed by the fact that the response of a German guard to a prisoner who complains at being unfairly beaten, is exactly the same as the Tralfamadorian's response to Billy: 'Vy you? Vy anybody?' The Tralfamadorian view, and that of the guard, allow for a complete abnegation of individual responsibility.

⁶³Vonnegut, *Slaughterhouse-Five* 62.

Taking life moment by moment is precisely what Billy does, even though the moments of his life do not occur in a linear order because of his uncontrolled time travelling. Like many of Vonnegut's protagonists he is a passive victim of circumstances, doing little to control the course of events in which he is caught. Believing that history is set, he sees no need to attempt to change it.

It is because of this that the integration of a science-fiction novel with one about war is such an imaginative and successful venture on Vonnegut's part. To understand why this is the case, we need to take a short detour into the issues that Vonnegut raises in the first chapter of the book, where he writes about the background to

Slaughterhouse-Five. It is here that he himself struggles with the questions raised by adopting a philosophy akin to that of the Tralfamadorians, because as a writer of a war novel he too is caught up in the problem of whether individual actions have any influence upon the unfolding of large-scale events. For instance, the (fictional?) movie-maker Harrison Starr asks him why he does not write an anti-glacier book instead of an anti-war book, a rhetorical question which Vonnegut interprets as meaning that anti-war books are futile ventures: 'What he meant, of course, was that there would always be wars, that they were as easy to stop as glaciers. I believe that, too.'⁶⁴

However, just as there was no final judgement on the question of whether there is any meaning to human life in *Galápagos*, so Vonnegut leaves the question of whether individual actions have meaning unanswered in *Slaughterhouse-Five*. On the one hand, there is the view of the Tralfamadorians that all things are as they are, and cannot be changed. Further support for this view comes from the disjointed form of the novel, the short, staccato feel imposed by frequent breaks and jumps reinforcing the sense of being flung backwards and forwards in time with Billy, unable to control anything. Repeated phrases also reinforce this sense of powerlessness. The constant response in the novel to death - 'So it goes' - suggests resignation in the face of the events which shape and end lives.

Yet the constant repetition of 'so it goes' (103 times - on nearly two out of every three pages - by my calculations) also implies the inadequacy of this viewpoint. Vonnegut has told us that he wants to write an anti-war book, but then presents us with indifference in the face of death. This suggests an ironic stance, and also an attempt to draw our attention to the dehumanising effects of war, and the fact that language is inadequate to express such horror, much as the characters in *Cat's Cradle*, finding themselves incapable of expressing what had happened to their world, fell back on cliché. As Vonnegut puts it early on in *Slaughterhouse-Five*, '[this book] is so short and jumbled and jangled . . . because there is nothing intelligent to say about a

⁶⁴Vonnegut, *Slaughterhouse-Five* 3.

massacre.⁶⁵ Reality, in all its complex and terrible immensity, outstrips attempts to represent it.

What Vonnegut seems to be doing then, is writing about the problems of writing about events like wars. The alien philosophy of the Tralfamadorians is used to represent the view that nothing will change, regardless of what we do and what we write. By counterpointing two genres - science fiction and war fiction - Vonnegut makes us question the values of each. War fiction often presupposes the efficacy of individual actions - if it portrays war as an adventure, then it assumes that individuals' actions have a purpose which can be realised; and if it adopts an 'anti-war' stance, then it assumes that writing about the experience of war may help to change people's attitudes towards it. The Tralfamadorians deny any validity to this view of the potency of individual actions in their re-education of Billy, and their presence in the novel also serves to undercut that staple of science fiction, the hyper-intelligent alien race who have learnt to overcome the problems that still face mankind - all the Tralfamadorians can offer is the knowledge that our actions are meaningless. The juxtaposition of two such antithetical genres also makes suspension of disbelief extremely difficult for the reader, and forces us to think about the status of the novel as fiction - even though it is based upon Vonnegut's own experiences.

A very different reading of the novel, which retains the elements dealing with Billy's life during and after the war as 'real' events, but makes the science-fiction episodes into fantasies of Billy's, is of course possible. Yet this possibility that Billy is mad still takes us to a reading of the novel which makes it about the difficulty of writing about events like war, rather than being just about the bombing of Dresden itself. In this reading too, the novel searches for a way of saying something about a massacre which does have meaning, when placed in the context of the grand march of history. If Billy is mad then the novel is about the effects of the war upon him. How does our reading of the story evolve in this case?

Billy goes to war and witnesses the bombing of Dresden as a POW, returns to America and establishes a normal life for himself as an optician and family man. However, his experience in Dresden still affects him, though he does not realise it, and he often finds himself silently weeping out of all proportion to the circumstances.⁶⁶ Events in his life take him back to his war experiences, and it is these which he interprets as time travel: the black and orange tent at his daughter's wedding recalls the black and orange paint on the train wagons used to transport the POWs;⁶⁷ when he

⁶⁵Vonnegut, *Slaughterhouse-Five* 14.

⁶⁶Vonnegut, *Slaughterhouse-Five* 44-45.

⁶⁷Vonnegut, *Slaughterhouse-Five* 50, 52.

cries in the present he 'time travels' to the past where the wind is making his eyes water;⁶⁸ when he is cold his 'blue and ivory' feet recall those of corpses during the war;⁶⁹ and the first thing Billy does, when he arrives in the German prison camp and on Tralfamadore, is take off his clothes.⁷⁰ As well as time travelling, he also constructs an escape scenario for himself in the form of a fantasy of being kidnapped by Tralfamadorians and mated with the film star, Montana Wildhack, in a zoo on Tralfamadore. Here, also, there are echoes of his real life - Billy has seen Montana Wildhack in a film being shown in a porn shop,⁷¹ and elements of his experiences on Tralfamadore echo the science-fiction story, *The Big Board*, by Kilgore Trout, a writer to whom Billy is introduced by Eliot Rosewater.

However, he begins to gain awareness of the profound psychological effects of the war upon him, when he is moved to tears by a quartet of singing opticians, the Febs (Four-Eyed Bastards), at his eighteenth wedding anniversary: 'Here was proof that he had a great big secret somewhere inside, and he could not imagine what it was.'⁷² For the first time, he does not 'time travel' back to the past but imagines it, realising that the sight of the men's mouths opening and closing as they sing, is the same as that of the German guards when they were first confronted with the full horror of the aftermath of the Dresden bombing.

It is only now that Billy is able to confront what happened to him, albeit in the safe fantasy of his idyllic existence with Montana Wildhack in the Tralfamadorian zoo. Immediately after he makes the connection between the singers and the guards, she asks him to, 'Tell me a story.'⁷³ For the first time Billy speaks about his war experiences. His story starts in a cold, matter-of-fact tone: "Dresden was destroyed on the night of February 13, 1945," Billy Pilgrim began.⁷⁴ However, it is not long before we get to the climax of Billy's tale, and Vonnegut's, which is the effort to clean up Dresden by the American POWs and the surviving Germans, followed by the only

⁶⁸Vonnegut, *Slaughterhouse-Five* 46.

⁶⁹For example, Vonnegut, *Slaughterhouse-Five* 47, 52.

⁷⁰Vonnegut, *Slaughterhouse-Five* 60.

⁷¹Vonnegut, *Slaughterhouse-Five* 149.

⁷²Vonnegut, *Slaughterhouse-Five* 126.

⁷³Vonnegut, *Slaughterhouse-Five* 130.

⁷⁴Vonnegut, *Slaughterhouse-Five* 130. The fact that February 13th is the date on which Billy thinks he will die adds further weight to the argument that he imagines his time-travelling experiences, and that they are not real. The narrator also presages the year of Billy's 'imagined' death by saying that he looks like the central character in a parody of the painting, 'The Spirit of '76.'

piece of suffering with which Billy is really able to connect - the discomfort of the ill-shod horse for which he weeps.

In this reading the book is about Billy coming to terms with, and confronting, his experience at Dresden. He is unable to tell his wife, in the real world, about his war experiences, but finally manages to give expression to them in the safe environment of his fantasy life with Montana Wildhack. Billy's voicing of these experiences, and the way in which he finally manages to connect with some of the suffering - the horse's pain for which he bears some of the blame - finally brings us back to Vonnegut's own problems with writing about the war, which he told us about in the first chapter of the novel. So in its final pages the novel comes full circle.

In the first chapter Vonnegut told us about drinking into the night and ringing old girl friends, or war colleagues, after his wife had gone to bed, with his breath smelling like 'mustard gas and roses.'⁷⁵ In the final chapter we are told that Billy and the other POWs work to pull bodies out of the 'corpse mines' of Dresden, and we are reminded of this smell: 'There were hundreds of corpse mines operating by and by. They didn't smell bad at first, were wax museums. But then the bodies rotted and liquified, and the stink was like roses and mustard gas.'⁷⁶ This suggests that the novel is as much about Vonnegut coming to terms with Dresden (and the reader making the link between the smell of his breath, and that of the corpses), and writing his story through a fantasy, as it is about Billy himself coming to terms with his experience and expressing it through a fantasy. Just as *Catch-22*, despite its dislocations of chronology, slowly and carefully builds to the cathartic, full description of Snowden's death which appears near the end, so *Slaughterhouse-Five* moves deliberately (and about five-hundred pages more quickly) to a description of the corpse mines of Dresden.

Of course, it is equally legitimate to read the novel as really being about time travel. Although this rather dramatically changes our reading of the details of the story, it does not change our more general perception of it. The story is still about the individual being moved by larger forces, and the deeper meaning of many episodes remains unchanged. For instance, there is the incident when, caught behind enemy lines, '[o]ne scout hung his head, let spit fall from his lips. The other did the same. They studied the infinitesimal effects of spit on snow and history.'⁷⁷ Whether Billy

⁷⁵Vonnegut, *Slaughterhouse-Five* 3, 5.

⁷⁶Vonnegut, *Slaughterhouse-Five* 157.

⁷⁷Vonnegut, *Slaughterhouse-Five* 35. A similar point, about grand forces dictating individual actions, is made by a transgression of the natural/artificial boundary which is similar to, though less pronounced than, that in Gibson's work. A boxcar seems to be alive to the German guards that patrol outside it, 'a single organism which ate and drank and excreted through its ventilators' (51). Conversely, the prisoners become inanimate objects, equatable with a boxcar here, and later on as 'a

later goes mad or not, this still expresses the overwhelming force of the march of events. Similarly, just as Vonnegut does write his war novel and does tell his sons to disassociate themselves from massacre machinery (something that Billy fails to do, given that his son joins the marines and fights in Vietnam), so too does Billy express his experiences, eventually speaking in public about his experiences on Tralfamadore and, possibly in a fantasy, addressing a large crowd before his death with his message. He does therefore eventually take positive action. Paradoxically, the message Billy wants to communicate, when he finally takes this positive action and gives his speech, is about passivity and accepting what will happen, but it is, precisely because of this paradox, entirely fitting for the novel.

As in his other novels, Vonnegut is exploring change over time through the tension between self-determination and the individual's powerlessness in the face of larger forces. Some sort of ideal middle ground between the two is proposed in the novel, and is expressed in the rhyme that is framed on Billy's office wall, and inscribed on a locket around Montana Wildhack's neck: 'God grant me the serenity to accept the things I cannot change, courage to change the things I can, and wisdom always to tell the difference.'⁷⁸ When, early on in the novel, we discover that this hangs on Billy's office wall, we are told that '[a]mong the things Billy Pilgrim could not change were the past, the present, and the future.'⁷⁹ In other words he is, at this stage, completely powerless. The second appearance of the verse signals a change though, and by the time it reappears in the novel Billy does have some control over his life: after we are told about Montana's locket, we come to the final chapter where we run through the story about the corpse mines, and finish the book with Billy about to ride into the city on the wagon drawn by the maltreated horse. The first event - the bombing of Dresden - Billy cannot change. The second event - the cruelty to the horse - he can (and, as we know, does not). He fails to discern this difference, but at least Vonnegut himself, by putting the verse into the novel, manages to give expression to the existence of a mid-point between the individual being free to take action, and the individual being completely at the whim of determining outside forces.

Slaughterhouse-Five is then, if anything, a protest at the 'so it goes' attitude of the Tralfamadorians. Just as *Galápagos* offers the awful possibility that human life is meaningless, that the world is unforgiving, and that there is no teleology or purpose to the history of life, so *Slaughterhouse-Five* raises the fear that our actions are not our

liquid which could be induced to flow slowly toward cooing and light' (58). In these examples individual actions cease to have meaning because the prisoners do not exist as individuals to the guards.

⁷⁸Vonnegut, *Slaughterhouse-Five* 44, 153.

⁷⁹Vonnegut, *Slaughterhouse-Five* 44.

own, offering itself as a sincere hope that the actions of the individual - the writer - do have meaning and do have an effect.

(v) The Author as a Deterministic Force in the Fictional Universe of the Novel: *Breakfast of Champions*

Although *Breakfast of Champions* drops time travel as a plot device, it still explores the same themes in much the same way. What distinguishes this novel from the others though, is that it incorporates a self-reflexive drive. Admittedly, there are important elements of self-reflexivity in *Slaughterhouse-Five*, which will have been apparent from my discussion of it above. However there is little *direct* contact between Vonnegut and the fictional world he creates, apart from one late-night telephone call that Billy receives from a drunk (presumably Vonnegut) whose breath smelt of 'mustard gas and roses.'⁸⁰

In *Breakfast of Champions* the author figures much more prominently in the fictional world that he creates, and Vonnegut uses this to explore the way in which he acts to determine the lives of the characters he creates, robbing them of free will. The notional plot of the novel is driven by the events leading to the meeting between Kilgore Trout and Dwayne Hoover on the eve of an Arts festival in Midland City, and the violent rampage Dwayne goes on after becoming convinced that he is the central character in a Kilgore Trout science-fiction novel. However the real plot drive is the one that leads Kilgore Trout into a meeting with Kurt Vonnegut, and the discussion they have in which Vonnegut reveals to Trout that he is just a character in a novel.

How does this self-reflexive drive develop the idea that a meaningless determinism shapes the course of events as they take place over time? Most importantly, it provides a context in which Vonnegut can explore the writing of novels and the control that he wields over his characters. It also allows him to make clear how he hopes his fiction differs from that of other writers.

Just as *Galápagos* and *Wonderful Life* create an intellectual history for themselves, by distancing their accounts of evolution from past versions of the theory, so Vonnegut creates a similar history for himself in *Breakfast of Champions*, by distancing himself from realist novels. He does this by creating a fictional novelist, Beatrice Keedsler, who is in Midland City for the Arts festival, and who represents writers of the sort of fiction of which Vonnegut disapproves. He has 'no respect' for Keedsler, whom he accuses of joining 'hands with other old-fashioned storytellers to make people believe that life had leading characters, minor characters, significant

⁸⁰Vonnegut, *Slaughterhouse-Five* 53.

details, insignificant details, that it had lessons to be learned, tests to be passed, and a beginning, a middle, and an end.'⁸¹

He can then contrast his own writing style with this 'old-fashioned' kind. Keedsler works by creating order out of disorder. Vonnegut, on the other hand, does the opposite. He claims that individuals are mistreated because, influenced by conventional storytelling, governments are used to viewing them as disposable bit-part actors. His writing therefore tries to shun literary convention (even more so in this novel, where so much space is taken up by child-like drawings, than in the others):

Once I understood what was making America such a dangerous, unhappy nation of people who had nothing to do with real life, I resolved to shun storytelling. I would write about life. Every person would be exactly as important as any other. All facts would also be given equal weightiness. Nothing would be left out. Let others bring order to chaos. I would bring chaos to order, instead, which I think I have done.

If all writers would do that, then perhaps citizens not in the literary trades will understand that there is no order in the world around us, that we must adapt ourselves to the requirements of chaos instead.⁸²

There are obvious parallels here with the writing I discussed in chapter five, which detailed the privileging of chaos over order in contemporary fiction. Passages like this suggest that there is a common postmodern discourse that not only runs between the work of Vonnegut and Gould, discussed in this chapter, but also from here to the disruptions of the chaos/order distinction which I explored in the works of Gleick, Prigogine, and Pynchon in chapter five.

There is also a strong link to the disruption of the human/machine dichotomy, discussed elsewhere in relation to the work of Dawkins and Gibson. *Breakfast of Champions* presents many of its characters as machines, and brings to the fore the transgression of the natural/artificial boundary that we found in the earlier novels: black prostitutes 'had grown up in the rural south of the nation, where their ancestors had been used as agricultural machinery';⁸³ 'in the interests of survival, they [women] trained themselves to be agreeing machines instead of thinking machines';⁸⁴ and in a

⁸¹Kurt Vonnegut, *Breakfast of Champions* (London: Jonathan Cape, 1973) 209.

⁸²Vonnegut, *Breakfast of Champions* 210.

⁸³Vonnegut, *Breakfast of Champions* 72.

⁸⁴Vonnegut, *Breakfast of Champions* 136.

phrase which recollects the central premise of *Player Piano*, Bunny is a 'piano controller'⁸⁵ rather than a piano player.

This treatment of people as machines, ties in with the idea of Vonnegut as a dictatorial controlling force in the fictional world. This becomes apparent when a self-reflexive aside leads Vonnegut into a general discussion about fiction:

I had come to the conclusion that there was nothing sacred about myself or about any human being, that we were all machines, doomed to collide and collide and collide. For want of anything better to do, we became fans of collisions. Sometimes I wrote well about collisions, which meant I was a writing machine in good repair. Sometimes I wrote badly, which meant I was a writing machine in bad repair.⁸⁶

Vonnegut here gives vent to the idea that we are all nothing more than deterministic machines. He also appreciates that this can be a highly dangerous notion, because it can have disturbing ramifications for how we view our fellow humans, and the responsibility we take for our actions. Just as the guard in *Slaughterhouse-Five* uses an appeal to determinism to justify hitting a prisoner for no apparent reason (see my discussion of this in footnote sixty-two), so Dwayne Hoover finally goes mad, and embarks on his violent spree, when he thinks that Kilgore Trout's novel is telling him that everyone is a machine, without free will, except him: 'He then socked Beatrice Keedsler on the jaw. He punched Bonnie MacMahon in the belly. He honestly believed that they were unfeeling machines.'⁸⁷

As with the earlier novels, however, Vonnegut does hold out the hope that we are more than machines - or at least a mixture of the machine-like and the human. This hope comes from the abstract artist, Rabo Karabekian, who expresses an alternative (or at least an addition) to the idea that people are machines. Vonnegut initially despises Karabekian as much as he does the novelist, Beatrice Keedsler, accusing him of entering 'into a conspiracy with millionaires to make poor people feel stupid.'⁸⁸ However, he is redeemed in Vonnegut's eyes when he takes the trouble to explain his painting, *The Temptation of Saint Anthony*, to the people - Vonnegut himself feels that 'my life was being renewed by the words of Rabo Karabekian.'⁸⁹ His painting, a huge

⁸⁵Vonnegut, *Breakfast of Champions* 181.

⁸⁶Vonnegut, *Breakfast of Champions* 219-20.

⁸⁷Vonnegut, *Breakfast of Champions* 259.

⁸⁸Vonnegut, *Breakfast of Champions* 209.

⁸⁹Vonnegut, *Breakfast of Champions* 223.

green rectangle with a vertical stripe in dayglo orange reflecting tape at one end, is crucial to the novel. Karabekian explains it like this:

[T]he picture . . . shows everything about life which truly matters, with nothing left out. It is a picture of the awareness of every animal. . . . A sacred picture of Saint Anthony alone is one vertical, unwavering band of light. If a cockroach were near him, or a cocktail waitress, the picture would show two such bands of light. Our awareness is all that is alive and maybe sacred in any of us. Everything else about us is dead machinery.⁹⁰

It is this which offers the hope that we are more than machines in the novel, and that we have an awareness, a consciousness, which cannot be reduced to machine-like terms.

This novel goes further than the previous ones, because Vonnegut does not only explore the consequences of the universe being nothing more than a machine, he also explores the idea that fictional universes are machines created by despotic writers, and so casts himself in a role which is that of a huge, external, determining force on the lives of his characters. Yet the awareness that is represented by the orange stripe in Karabekian's painting offers the hope that we can become more than machines. It also offers the hope that Vonnegut's novel can become more than a machine created by him, because he is himself more than a machine: 'And this book is being written by a meat machine in cooperation with a machine made of metal and plastic. . . . And at the core of the writing meat machine is something sacred, which is an unwavering band of light.'⁹¹

If the hope that Vonnegut expresses here is borne out, then we are fusions of machine and independent awareness, able to have some control over the deterministic processes that shape our lives. In expressing this hope, Vonnegut is forced to concede that he cannot control his characters completely, and that he must grant them some freedom to control their world: 'Here was the thing about my control over the characters I created: I could only guide their movement approximately, since they were such big animals. There was inertia to overcome. . . . [It was] as though I was connected to them by stale rubberbands.'⁹²

This is the climax of the evolution of the ideas about free will and determinism that I have traced through this selection of Vonnegut's work. He proposes here a

⁹⁰Vonnegut, *Breakfast of Champions* 221.

⁹¹Vonnegut, *Breakfast of Champions* 225. Vonnegut also suggests that scientists should come to terms with the role that awareness plays in their work, claiming that $E=Mc^2$ is a 'flawed equation' because there 'should have been an "A" in there somewhere for *Awareness* - without which the "E" and the "M" and the "c," which was a mathematical constant, could not exist.' Vonnegut, *Breakfast of Champions* 241.

⁹²Vonnegut, *Breakfast of Champions* 202.

fusion of free will and determinism - of the machine and the unwavering band of light - that puts into practice the verse inscribed on Montana Wildhack's locket in *Slaughterhouse-Five*, and offers the middle way between humans and machines first called for in *Player Piano*. This is not by any means a comfortable resolution, because the unwavering band of light is offered more in hope than in reality. Nevertheless, it is at least there as a possibility - something which cannot be said of much of the earlier fiction.

By the time we get to *Galápagos*, Vonnegut has become a little more cynical again, and there is a sense in which human fate is determined purely by outside forces, even though a little hope is expressed that we have some purpose in this world. In a view of evolution which is identical to that proposed by Gould, he finds an apt means for expressing the idea of the individual life, shaped by an indifferent universe, which has obsessed him throughout his career. The idea of time that he proposes in this novel does not therefore come solely from the scientific concept with which he deals. The notion of free will pitted against determinism which I have traced through this sequence of novels, leads him to explore a view of change over time that mirrors one arrived at, seemingly independently, in presentations of evolution by scientists: things are determined, but with no reason (beyond the laws of physics) and to no purpose. This suggests that he does not so much take an idea from science, but that he sees in science a means of expressing those ideas that he has arrived at independently. In the light of this, it is not unreasonable to suggest that the sense of time that renounces teleology, identified by White, is indeed characteristic of postmodern discourses. Despite the close parallels between evolution as it is presented in *Wonderful Life*, and as it is presented in *Galápagos*, the really interesting connection between the two books is, not that Vonnegut should have used contingency in his novel, but that the foregrounding of this notion should accord with wider postmodern discourses of time.

CONCLUSION

SEISMIC DISTURBANCES IN ENLIGHTENMENT THOUGHT

CONCLUSION

It remains for me to make clear exactly how the first, theoretical section of my thesis relates to the second part, which detailed various practical examples of the shared discourses between literature and science. In the first four chapters I described a particular history from the Enlightenment to the postmodern which emphasised the transition from Enlightenment values, through a period of crisis, to contemporary, postmodern values. I did not argue that this was necessarily the 'right' history, but that it is one that is implicit in much contemporary literature and science writing - it is the version of history which is *assumed* by many postmodern writings and from which they take their character and identity. I called the shared assumptions of literature, science and literary theory a *core literature/science discourse*, and designated the final phase of this discourse as *postmodern* because its values are embedded in many of those texts which have been described as postmodern.

By following this section with three chapters analysing different themes in contemporary literature and science writing, I implied that the works of literature and science I was looking at are examples of the final, postmodern phase of the core discourse. In some of the examples I used, this was fairly self-evident because there was an implicit history which very obviously correlated with that I had identified in the first half of the thesis. Pynchon's novels, for instance, are often read as typical examples of postmodern literature. Vonnegut's also fit, though a little less easily, into this category. Gibson cites Pynchon as an influence, and so again, although his style of writing lacks the disorientating characteristics of Pynchon's, there is a 'postmodern' feel to the *Neuromancer* trilogy which comes out most strongly in the themes I analysed in chapter six.

Even though *postmodernism* is a term which is less likely to be recognised by scientists than by writers and literary critics, it is not necessarily problematic to designate some contemporary presentations of scientific ideas as postmodern. Chaos theory, the subject of chapter five, is frequently written into a very explicit history, which is remarkably similar to that constructed about postmodern literature and literary theory. One of the reasons it slots so easily into a 'postmodern' version of history is because it is a cross-disciplinary science which, by transcending boundaries, appears to be revolutionary. The very name, by implying the theorising of that which, by definition, should be untheorisable (chaos), suggests an overturning of assumptions which is similar to that which lies at the heart of the development of the core literature/science discourse I have described.

Gould's *Wonderful Life*, though not interdisciplinary in the way that chaos theory is, also sets itself up as describing a revolution in thought. Gould does not

make the claims for his subject which are made for chaos theory, but the overturning of orthodoxy in his book, aligns his work with the other texts I have described.

With all of these writers there is not necessarily a deliberate attempt to be postmodern - they may consciously or unconsciously align themselves with the *zeitgeist*, or it may be that the *zeitgeist* is so strong that their works are appropriated, by interpretation, into conformity with it. Certainly Dawkins stands as an example of this latter process. Unlike the work of the other writers, his texts do not construct an explicitly 'revolutionary' intellectual history for themselves. Contemporary developments in evolutionary theory are presented as additions to, and subtle tinkering with, the basically correct view proposed by Darwin in *Origin of Species*. Of course, Darwin himself is presented as a revolutionary figure in the history of ideas, but the revolution he represents is a very different one to the transition from Enlightenment to postmodern implied by the core literature/science discourse.

My interpretations of Dawkins' work are therefore appropriations of his books, claiming them as, in some respects, postmodern, even though there is no explicit intention on the author's part that they should be seen in this way.¹ I admit that this may seem rather disingenuous, as though I have invented a category (postmodernism), reinterpreted texts so that they fit into it, and then claimed that my interpretations prove that the category exists. Two points will serve to clear this problem up.

Firstly, it is only one aspect of Dawkins' work which I am interested in for the purposes of this thesis. The only respect in which his books are postmodern is in their working of the natural/artificial boundary in order to make certain points about evolution. In the process of making these points Dawkins calls into question - sometimes explicitly, sometimes implicitly - the divide between organism and machine, and life and non-life. This is similar to the transgression of these boundaries which occurs in some postmodern literature (I focused on Gibson but many other writers explore similar themes). Though Dawkins work is not postmodern in most respects (there is nothing pejorative in this statement; no value judgement is attached to the label 'postmodern'), this one facet of his work adds material to the store of cultural artefacts which are postmodern. Anyone who has read his books will have been aware of the sorts of metaphors (of digital information technology) that he uses to describe life. All I have attempted to do is to show how these metaphors currently saturate our culture - how they are integral to many of the stories that we tell about ourselves - by making the link between Dawkins and Gibson.

¹Of course, an interpretation of any text involves a degree of appropriation, because it requires a foregrounding of certain aspects of the text, at the expense of others, in order to make it fit into a wider, extra-textual framework. My point here, is that the appropriation has had to be greater than is normal in the case of Dawkins' work.

The second point is that the awkward fit between Dawkins' work and postmodernism, illustrates a fundamental feature of the core literature/science discourse I have postulated. This is that it is an artificial framework of interpretation. It has no pre-existent quality. Although I have given it a rather grandiloquent name for purposes of brevity, I am not trying to make an immodest claim to have 'discovered' the mechanism by which postmodern discourses come into existence and explain themselves. The core discourse is a model I have constructed to explain post-Enlightenment narratives, and should be treated as such.

That is, it should be used strictly according to its utility value. By schematising and simplifying the complex histories constructed by postmodern discourses I hope to have produced a broad outline of the interaction between literature and science in postmodernist contemporary writing. The core discourse, as I have presented it, is not the 'truth' that underpins postmodern literature, science and literary theory. It is an abstraction from the truth (from all those narratives that constitute our culture). However, although I have so far stressed the need to be cautious in using this idea of a core discourse, it also has a number of benefits.

First and foremost, it does give us a way of understanding the postmodern itself. Because it links disparate areas like literature and science, it enables us to appreciate how extensive postmodern discourses are, and what characterises them. Also, by exposing the shared history which they construct, it enables us to look critically upon that history, and the rather simplified understanding of the Enlightenment which it supposes. I have been concerned with how postmodern discourses present themselves in this thesis, rather than the limits of those presentations, but two possible accusations that might be levelled at the assumptions of postmodernist discourses are: their suggestion that the Enlightenment assumed a wholly straightforward view of reality; and the contradiction that is apparent in their simultaneous critique of teleology, and claim to come at the end of a process of historical development (post modern).

Another advantage of using the core literature/science discourse as a model, is that it provides a coherent articulation of the replacement of the idea that literature and science are irreconcilably different, by a new conception of culture which enables us to see the ways in which they are equivalent. This new view of the culture attempts to expose the inadequacies of established binarisms (the Arts versus the Sciences), replacing them with a sense of culture that is paradoxically both singular and multiple. It is singular because we are enmeshed in a vast complex of interweaving narratives that run through and between the various sites of culture, connecting literature and science. It is multiple because there is not one, driving narrative that determines all others.

It is this move away from Enlightenment binary oppositions which I attempted to draw out in my case studies. Each one illustrated the ways in which contemporary

literature and science writing is engaged in undermining established binary divides, which have permeated our thought and our language for so long. This is not to say that the discourses I have studied are necessarily liberating influences, and they are no doubt dependent on other assumptions. What they do let us do, is think about the binary oppositions with which the Enlightenment is associated, and the possibilities that are offered by thinking beyond these.

Interestingly, there is a vibrant dialogue of ideas, not only between the literature and science in each case study, but also between the different case studies. For instance, Vonnegut plays with the idea of humans as machines just as much as Gibson. I made passing references, in the course of the second section, to some of these echoes between the different chapters, but it is worth elucidating them a little further here. The most striking feature is that the conflicts between each binary opposition are in some senses equivalent: *order*, *globalisation*, *machine*, *artifice*, and *determinism* all have something in common; as do *disorder*, *localisation*, *human*, *life*, and *free will*. This does not mean that each list of words is a group of synonyms (it would, for instance, be hard to justify *human* and *disorder* as being equivalent in meaning), but it does mean that they deal with associated concepts: the quest for order is the quest for a global structure, and machines imply determinism; conversely, disorder suggests a fracturing of the global into a series of local, disconnected fragments, and the Romantic view of the human is the view of that which is self-determined, not governed by outside forces.

It is therefore useful to think of each site of a binary divide being linked to the others by a common fault line, albeit one that traces a tortuous and twisted path. The postmodern discourses which I have discussed work this fault line, reconfiguring the relationship between the different elements which lie on either side of it, and suggesting new ideas that straddle it. At many of the sites the long-term effect of these postmodern discourses may be insignificant, and they may offer no more than passing tremors and rumbles of disquiet which will soon pass. However, at others sites the fault line may be active enough to produce some significant seismic activity, creating a whole new landscape onto which we must map our knowledge.

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