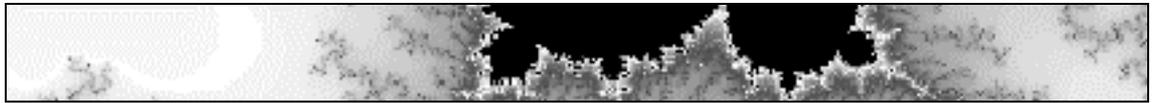


INTRODUCING CHAOS THEORY



The aim of this thesis is to critically examine the appropriation of nonlinear dynamical systems theory, or ‘chaos theory’ as it is commonly known, by contemporary literature and cultural studies. The fundamental argument that will be presented here is that in the last thirty years the “new science” of chaos theory, as it is characterised by science writers like James Gleick in his ground-breaking popular text *Chaos: Making a New Science* (1987), has become a prominent feature of the late twentieth century’s worldview that has impacted on literature as much as on any other discipline or site in western culture.¹ In order to formulate a critical examination of the literary appropriation of chaos theory, it is necessary to comprehend the fundamental characteristics of chaos theory. Chaos theory is inscribed in a number of contexts, including but not limited to, ‘hard’ scientific texts, ‘popular’ science texts, and literary texts. An understanding of its concepts and principles may be gained from consideration of the many popular science texts that discuss chaos theory, many of which are written by scientists who have significantly contributed to its development.

This thesis will examine how chaos theory, particularly as it is inscribed in popular science texts, has impacted on literary texts. The chaologist Ian Stewart defines his science in *Does God Play Dice? The New Mathematics of Chaos* (1990) as the study of the stochastic behaviour of deterministic systems.² Chaos theory examines the phenomenon of deterministic chaos, which is described by the chaologist Ilya Prigogine and the historian Isabelle Stengers in *Order out of Chaos: Man’s New Dialogue with Nature* (1984) as the seemingly paradoxical combination of uncertainty and

¹ James Gleick, *Chaos: Making a New Science*, London: Cardinal, 1988, p. 4.

² Ian Stewart, *Does God Play Dice? The New Mathematics of Chaos*, London: Penguin, 1990, pp. 16-17. Chaos scientists are variously known as chaologists, chaoticists, or chaosophers. Stewart prefers ‘chaosopher’ but most other commentators use ‘chaologist.’ See *Does God Play Dice?*, p. 125. Gleick notes the use of either ‘chaoticist’ or ‘chaologist’ in *New Science*, p. 38.

determinism.³ Chaologists hypothesise that chaotic systems contain indeterminate information that remains indecipherable to the reductive interpretative methodology of classical physics, yet is not in itself meaningless. The scientific purpose of chaos theory is to develop strategies and techniques to make sense of this chaotic information.

In addition to examining how chaos theory concepts have been interpreted and represented by literature, this thesis will concern itself with how other ideas, including those adopted by literature from philosophy, and particularly the philosophy of science, have contributed to the contemporary literary interest in chaos theory. One such idea which has influenced the literary interpretation of chaos theory is that of the paradigm. The philosopher of science Thomas Kuhn argues in *The Structure of Scientific Revolutions* (1970) that the history of ‘normal’ science is marked by gradual progress within an area or framework of thought, but is occasionally punctuated by major ‘shifts’ in the prevailing scientific worldview. He suggests that science becomes ‘paradigmatic’ when either a substantial new discovery is made, or when a fundamentally new approach to the study of a particular field is developed.⁴ The concept of the paradigm shift has been widely adopted by many post-Kuhnian scientists and philosophers of science due to its capacity to systematically structure the history of science. Paradigm theory is also popular in the humanities because, as David Locke argues in *Science as Writing* (1992), it is useful in delineating the boundaries between literary periods.⁵ In this context the concept of the paradigm is used, for example, to delineate between modernity and postmodernity.

In *Paradigms and Revolutions: Appraisals and Applications of Thomas Kuhn’s Philosophy of Science* (1980) Gary Gutting argues that paradigms function in two ways. Firstly, paradigms construct a ‘super-theory’ which draws ideas together into a coherent worldview. In *The Matter Myth: Beyond Chaos and Complexity* (1992), for example, Paul Davies and John Gribbin identify the Kuhnian paradigm as a “framework of thought” which defines an area of study.⁶ Secondly, Gutting argues that paradigms

³ Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man’s New Dialogue with Nature*, London: Flamingo, 1985, p. 9.

⁴ Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Second Edition, Chicago: University of Chicago Press, 1970.

⁵ David Locke, *Science as Writing*, New Haven: Yale University Press, 1992, p. 10.

⁶ Paul Davies and John Gribbin, *The Matter Myth: Beyond Chaos and Complexity*, London: Penguin, 1992, p. 1.

create a consensus amongst scientists: they become a focal point that unites a group of scientists.⁷ A paradigm shift therefore encapsulates not only a set of values: it also identifies those who share those values. Some chaologists, and various commentators on chaos theory, argue that it represents a Kuhnian paradigm shift that embodies new ideas about the behaviour of chaotic or complexly ordered natural and artificial systems, such as weather patterns and computer networks. Chaos theory fulfils these criteria by drawing together ideas about the behaviour of nonlinear dynamical systems and associating the scientists who study nonlinear dynamical systems with the ‘new science’ of chaos theory.

Chaos theory’s appeal within literature has been induced to a significant degree by popular texts like *New Science* and *Order out of Chaos*, for these texts define chaos theory as an anti-establishment, holistic science that differs both epistemologically and methodologically from traditional science and which places considerable emphasis on themes and values that are already prevalent in the humanities. Gleick argues in *New Science* that chaos theory defines itself in opposition to western science’s mechanistic Newtonian tradition, and that the “most passionate advocates of the new science go so far as to say that twentieth-century science will be remembered for just three things: relativity, quantum mechanics, and chaos. Chaos... has become the century’s third great revolution in the physical sciences.”⁸ This argument is endorsed by the critics and theorists who will be collectively defined here as the ‘postmodern appropriators of chaos theory.’ Douglas L. Kiel and Euel Elliott, for instance, argue in *Chaos Theory in the Social Sciences: Foundations* (1996) that:

The emerging paradigm of chaos... has profound implications for the previously dominant Newtonian view of a mechanistic and predictable universe. While a Newtonian universe was founded on stability and order, chaos theory teaches that instability and disorder are not only widespread in nature, but essential to the evolution of complexity in the universe. Thus, chaos theory, as relativity theory and quantum theory before it, presents another strike against a singular commitment to the determinism of a Newtonian view of the natural realm.⁹

⁷ Gary Gutting, Introduction to *Paradigms and Revolutions: Appraisals and Applications of Thomas Kuhn’s Philosophy of Science*, edited by Gary Gutting, Notre Dame: University of Notre Dame Press, 1980, pp. 1-2.

⁸ Gleick, *New Science*, p. 6.

⁹ Douglas L. Kiel and Euel Elliott, *Chaos Theory in the Social Sciences: Foundations and Applications*, Ann Arbor: The University of Michigan Press, 1996, p. 2.

Accounts such as this suggest that chaos theory represents the development of a worldview that incorporates the accumulated discoveries of twentieth-century science.

In the same thirty years that chaos theory has consolidated its place in the scientific arena, the literary, artistic, and cultural movement known as postmodernism has become the defining paradigm of late-capitalist, post-industrial western society.¹⁰ One characteristic of postmodernism is its willingness to appropriate discourses from disparate origins, and its eagerness to exploit the uncertainty and ambiguity that results from these appropriative acts. The purported epistemological power of chaos theory to explain complex nonlinear events has led some critics to consider whether chaos theory may be applicable to social systems. Kiel and Elliott argue in support of the hypothesis that chaos is applicable to social systems, stating that it represents a “means for enhancing both the methodological and theoretical foundations for exploring the complexity of social phenomena.”¹¹ The literary and cultural appropriation of chaos theory takes a number of forms: critics discuss chaos theory and attempt to ascertain its relevance for the humanities; they adapt, modify, and contextualise its principles to suit the parameters of literary and cultural studies; and they apply this appropriated, modified discourse to the examination of social and fictional systems. The ideas embodied within the science of chaos theory are inscribed and reinscribed throughout contemporary literary discourse.

The literary interpretation and application of chaos theory is founded on two basic premises: that similarities exist between it and postmodernism to the extent that the two may be considered chronologically and theoretically parallel paradigms, and that the social and fictional systems studied by the humanities are comparable with the systems studied by science.¹² The philosopher of science Stephen H. Kellert states in his text *In*

¹⁰ There are numerous texts which examine the nature of postmodernity. For a selective representation, see Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, translated by Geoff Bennington and Brian Massumi, Manchester: Manchester University Press, 1984; David Harvey, *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change*, Oxford: Blackwell, 1989; Brian McHale, *Constructing Postmodernism*, New York: Routledge, 1992; Terry Eagleton, *The Illusions of Postmodernism*, Cambridge: Blackwell, 1996; Linda Hutcheon, *A Poetics of Postmodernism: History, Theory, Fiction*, New York: Routledge, 1988; John McGowan, *Postmodernism and its Critics*, Ithaca: Cornell University Press, 1991; and E. Ann Kaplan, ed., *Postmodernism and its Discontents: Theories, Practices*, New York: Verso, 1988.

¹¹ Kiel and Elliott, *Chaos Theory in the Social Sciences*, p. 3.

¹² The development of parallel paradigms like chaos theory and postmodernism is neither a new nor remarkable phenomenon according to Gregoire Nicolis and Ilya Prigogine, who point out that twin or mutual paradigms have developed before. They cite the development of the theory of evolution in

the Wake of Chaos: Unpredictable Order in Dynamical Systems (1993) that when scientists study something, they “draw a figurative frame around the subject matter of their inquiry and label the contents of that frame a ‘system.’”¹³ The term ‘system’ may be applied in any discipline to sets of related objects or events to better understand the ways in which they are inter-related. The literary interpretation of chaos theory relies heavily on popular accounts of the scientific concept of the system.

A number of influential texts have been published in the past two decades to document the perceived similarities between chaos theory and postmodernism. In *Contesting Earth’s Future: Radical Ecology and Postmodernity* (1994) Michael E. Zimmerman argues that “chaos theory seems compatible with postmodern theory’s critique of modernity’s search for a univocal, stable structure that organizes all phenomena.”¹⁴ Zimmerman suggests that one of the most obvious similarities between chaos theory and postmodernism is that both paradigms reject the linear causal models and structures of the paradigms that precede them: Newtonian science and modernism. Like chaos theory, postmodernity acknowledges a collapse of the ‘modern’ categories of logic, objectivity, rationality, and instead promotes an epistemology based on the principles of indeterminism and uncertainty.¹⁵

Morse Peckham describes the development of parallel paradigms like chaos theory and postmodernism in *Man’s Rage for Chaos: Biology, Behavior and the Arts* (1967) as “cultural convergence,” a concept which refers to “the phenomenon that different individuals in the same culture arrive at the same solution to a problem, but quite independently of each other.”¹⁶ The convergence of chaos theory and postmodernism is essential to its appropriation by the humanities. Significantly, postmodernists are not the only contemporary thinkers who assert that the paradigms of

biology and thermodynamics during the nineteenth-century as an example. See Nicolis and Prigogine, *Self-Organization in Nonequilibrium Systems: From Dissipative Structures to Order through Fluctuations*, New York: John Wiley and Sons, 1977, p. 2. See also Prigogine, “Unity of Physical Laws and Levels of Description,” in *Interpretations of Life and Mind: Essays around the Problem of Reduction*, edited by Marjorie Grene, London: Routledge and Kegan Paul, 1971, pp. 1-13, p. 1.

¹³ Stephen H. Kellert, *In the Wake of Chaos: Unpredictable Order in Dynamical Systems*, Chicago: The University of Chicago Press, 1993, p. 2.

¹⁴ Michael E. Zimmerman, *Contesting Earth’s Future: Radical Ecology and Postmodernity*, Los Angeles: University of California Press, 1994, p. 13.

¹⁵ For a further discussion of the epistemology of science see Paul Karl Feyerabend, *Against Method*, revised edition, London: Verso, 1988.

¹⁶ Morse Peckham, *Man’s Rage for Chaos: Biology, Behavior and the Arts*, New York: Schocken

chaos theory and postmodernism display a significant degree of convergence: chaologists like Prigogine also argue that this is the case. Prigogine and Stengers state that they deliberately chose *La Nouvelle Alliance* - the original French title of *Order out of Chaos* - to define their study, which they describe as the “convergence of science and the humanities.”¹⁷ This idea of the convergence of ideas between science and the humanities is pivotal in the discourse used to endorse and explain the literary appropriation of chaos theory.

The convergence of chaos theory and postmodernism is the topic of the most influential literary interpretation of the science to yet emerge from the humanities: N. Katherine Hayles’ *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (1990). Hayles establishes the tone and style of the literary interpretation of chaos theory in *Chaos Bound*, arguing that:

it would be a mistake to think that chaos theory has no significant consequences for the humanities. On a deep level, it embodies assumptions that bring into question presuppositions that have underlain scientific conceptualizations for the last three hundred years.¹⁸

In *Chaos Bound* Hayles is concerned with defining the boundaries of the literary use of chaos theory, and with examining the similarities and differences between chaos theory and postmodernism, particularly the reading methodology known as deconstruction. She suggests that science and culture have become closely associated in the postmodern period, most noticeably in the way that chaos theory and deconstruction subvert the dominant values of established paradigms: “the science of chaos reveals a territory that cannot be assimilated into either order or disorder; deconstruction detects a trace that cannot be assimilated into the binary oppositions it deconstructs.”¹⁹

In her Introduction to *Chaos and Order: Complex Dynamics in Literature and Science* (1991) Hayles further considers the idea of an indivisible relationship between postmodernism and chaos theory:

Books, 1967, p. 11.

¹⁷ Prigogine and Stengers, *Order Out of Chaos*, p. xxix. Later, they give a specific example of the convergence of scientific and non-scientific worldviews, and cite the philosophies of theologians and physicists as an example. See *Order Out of Chaos*, p. 49.

¹⁸ N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science*, Ithaca: Cornell University Press, 1990, p. 16.

¹⁹ *Ibid.*, pp. 16-17.

chaos theory is influenced by the culture within which it arose... [and] it is one site within the culture where the premises characteristic of postmodernism are inscribed. The postmodern context catalyzed the formation of the new science by providing a cultural and technological milieu in which the component parts came together and mutually reinforced each other until they were no longer isolated events but an emergent awareness of the constructive roles that disorder, nonlinearity, and noise play in complex systems.²⁰

Hayles defines the “complex interconnections” of theory, technology, and culture as the subject of her study, and focuses on the ‘feedback loops’ which link science and culture, arguing that such feedback loops are indicative of the close relationship between chaos theory and postmodernism.²¹

T. R. Young identifies other similarities between chaos theory and postmodernism in “Chaos and Social Change: Metaphysics of the Postmodern” (1991), arguing that chaos theory “decenters” determinism, certainty, coherence, and order from primacy in science and therefore that it is compatible with the indeterminate, uncertain parameters of postmodern culture.²² He suggests that chaos theory displaces “all claims of perfection, finality, normality or historical necessity” from their elevated, unquestioned positions in a similar manner to postmodernism, and argues from this that chaos theory provides “an elegant theoretical envelope in which to locate postmodern science.”²³ The “postmodern science” of chaos theory shares with other postmodernisms a worldview that is predicated not on determining the origins of things but on examining how things change.²⁴ In “Dimensions of Postmodern Culture” (1988) another critic, John W. Murphy, describes one example of this preoccupation with change; he argues, with reference to the philosophers of science Frederick Ferre and Stephen Toulmin, that one of the defining characteristics of postmodern science is a conscious abandonment of the

²⁰ Hayles, Introduction to *Chaos and Order: Complex Dynamics in Literature and Science*, edited by N. Katherine Hayles, Chicago: University of Chicago Press, 1991, p. 5.

²¹ Hayles, *Chaos Bound*, p. xiv.

²² T. R. Young, “Chaos and Social Change: Metaphysics of the Postmodern,” in *The Social Science Journal*, Volume 28, No. 3, 1991, pp. 289-305, p. 290. A revised version, titled “Chaos and the Drama of Social Change: A Metaphysic For Postmodern Science,” is available at www.tryoung.com/chaos/chang.htm (Jan 22 1998).

²³ *Ibid.*, p. 289.

²⁴ Floyd W. Matson introduced the term ‘postmodern science’ in *The Broken Image: Man, Science and Society*, New York: Garden City, 1964. See David Ray Griffin’s Introduction to *The Reenchantment of Science: Postmodern Proposals*, edited by David Ray Griffin, Albany: State of New York University Press, 1988, footnote 71, p. 41.

search for the origin of the cosmos, which since Newton has been identified as the primary goal of all science.²⁵

A number of scientists have also remarked at the similarities between chaos theory and postmodernism. The scientific contribution to discussions about the convergence of chaos theory and postmodernism has significantly altered the nature and tone of literature's interest in chaos theory. By introducing a different perspective on the literary implications of scientific ideas, science has contributed to the vigorous reflexive nature of contemporary chaos theory debate. The most significant representation of science's openness to cultural values is found in *Order out of Chaos*. Prigogine and Stengers recognise that the principles of chaos theory function as metaphors that are applicable to a wide variety of cultural, as well as physical, systems. The cultural applicability of chaos theory metaphors is affirmed by Locke, who argues in *Science as Writing* that a "major theme" of *Order out of Chaos* is the idea that "science cannot divorce itself from its cultural milieu."²⁶

The science writer Alvin Toffler agrees that science is deeply entrenched in culture, and that scientific ideas cannot be easily or simply distinguished from their cultural implications. In his Foreword to *Order out of Chaos*, Toffler discusses the influence of culture on science, and argues that:

Some scholars picture science as driven by its own internal logic, developing according to its own laws in splendid isolation from the world around it. Yet many scientific hypotheses, theories, metaphors, and models (not to mention the choices made by scientists either to study or to ignore various problems) are shaped by economic, cultural, and political forces operating outside the laboratory.²⁷

Toffler rejects the assumption that science is isolated from culture, and argues instead that science "is shaped by cultural receptivity to its dominant ideas."²⁸ Kellert agrees, suggesting that "cultural biases can profoundly affect the historical development of science by influencing the scientific community's notions of what counts as an interesting or worthwhile scientific phenomenon."²⁹

²⁵ John W. Murphy, "Dimensions of Postmodern Culture," in *Midwest Quarterly: A Journal of Contemporary Thought*, Volume 29, No. 3, Spring 1988, pp. 293-307, p. 299.

²⁶ Locke, *Science as Writing*, p. 165.

²⁷ Alvin Toffler, Foreword to *Order out of Chaos*, p. xii.

²⁸ *Ibid.*, pp. xii-xiii.

²⁹ Kellert, *Wake of Chaos*, p. 120.

The assertion that chaos theory is convergent with cultural values is supported by a number of other people working within science. The biologist Sally J. Goerner, for example, argues in “Chaos and Deep Ecology” (1995) that “[a]t its core, Chaos [theory] is about reconciling the two cultures.”³⁰ Goerner refers to the argument forwarded by C. P. Snow in *The Two Cultures* (1965) that the ‘two cultures’ of literature and science have become so isolated and separated from each other that communication between the two has become almost non-existent.³¹ Goerner’s account suggests that science’s self-isolating ideology is contested in and through the discourse of chaos theory by both science and by literature. In a similar manner, Friedrich Cramer explicitly attempts to “build a bridge” between science and the humanities to end the two cultures dichotomy in *Chaos and Order: The Complex Structure of Living Systems* (1993).³² The aim of these chaologists is to promote the establishment of a new worldview, based on the principles of chaos theory, that is accessible to both science and the humanities.

It is evident from the arguments presented in these and other texts that the establishment of the convergent paradigm of postmodernism and chaos theory has already begun.³³ The physicist John S. Nicolis argues in *Chaos and Information Processing: A Heuristic Outline* (1991) that “the paradigm of chaotic dissipative dynamics... has started a low profile widespread revolution” which has “deeply influenced” the way people “think about the ‘immutability’ of the physical world.”³⁴ This sentiment is echoed by Denny Gulick, who argues in *Encounters with Chaos* (1992) that an understanding of the concepts of chaos theory will lead people to “view the world a little differently.”³⁵ Yet another scientist, Harold J. Morowitz, suggests in *Entropy and the Magic Flute* (1993) that chaos theory’s implications have been “shattering not only to the world of physics but also to the philosophy of knowledge... The chaotic behavior of a class of dynamical systems touches everything from long-range weather forecasting

³⁰ Sally J. Goerner, “Chaos and Deep Ecology,” in *Chaos Theory in Psychology*, edited by Frederick David Abraham and Albert R. Gilgen, Westport: Greenwood Press, 1995, pp. 3-18, p. 17.

³¹ C. P. Snow, *The Two Cultures: And a Second Look*, Cambridge University Press, Cambridge, 1965.

³² Friedrich Cramer, *Chaos and Order: The Complex Structure of Living Systems*, Weinheim: VCH, 1993, p. xiv.

³³ The development of this new paradigm or worldview is viewed quite differently within science and the humanities. Whereas literary critics assume that such developments are inherently culturally specific, many scientists do not ordinarily adopt such relativistic points of view.

³⁴ John S. Nicolis, *Chaos and Information Processing: A Heuristic Outline*, Singapore: World Scientific, 1991, p. vii.

to the problem of free will.”³⁶ These statements suggest that chaos theory has relevance for disciplines beyond the sciences.

Critics draw on the analogies and metaphors scientists deploy in the dissemination of chaos theory, and in so doing they extend and contribute to the metaphorical language of chaos theory. The application of these metaphors and the manner in which they are constructed are issues that are of central concern in the literary interpreters of chaos theory. This thesis, in attempting to develop a critical understanding of the literary appropriation of chaos theory, will examine the operation of these metaphors in fictional and non-fictional texts. An initial hypothesis suggests that chaos theory metaphors have two essential functions: firstly, they ground abstract scientific concepts within specific discursive frames; and secondly, they provide cultural meanings for these abstract concepts. Detailed analysis of the metaphors literature has borrowed from popular chaos theory texts is essential to developing an understanding of how and why chaos theory has proven so popular in contemporary literary texts.³⁷

One of the most influential literary discussions of scientific metaphors is provided by Gillian Beer in *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction* (1983). Beer suggests that a shift has occurred in recent years in the scientific perception of metaphor and its role in the construction of scientific meaning, that the view “which saw metaphor as decorative and extraneous” has been replaced by a view which concedes that metaphors have an intrinsic place in scientific writing.³⁸ Beer outlines a number of ways in which the representation of scientific ideas in literary texts may be discussed. She argues that “[o]ne of the persistent impulses in interpreting evolutionary theory has been to domesticate it, to colonise it with human meaning, to bring man back to the centre of its intent.”³⁹ The literary adoption of chaos theory is explicitly acknowledged by critics like Neil Forsyth, who comments in “Chaos is come yet again” (1997), a review of Harriett Hawkins’ *Strange Attractors: Literature,*

³⁵ Denny Gulick, *Encounters with Chaos*, New York: McGraw-Hill, 1992, p. 3.

³⁶ Harold J. Morowitz, *Entropy and the Magic Flute*, Oxford: Oxford University Press, 1993, p. 210-211.

³⁷ A recent work that discusses metaphor is Roger M. White’s *The Structure of Metaphor: The Way the Language of Metaphor Works*, Blackwell: Oxford, 1996.

³⁸ Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction*. London: Routledge and Kegan Paul, 1983, p. 90.

³⁹ *Ibid.*, p. 10.

Culture, and Chaos Theory (1995), that chaos theory is “domesticated” and “normalized” in Hawkins’ text.⁴⁰ Beer’s description of the domestication of Darwinian evolutionary theory has important implications for considerations of the literary and cultural reception of chaos theory, and for this reason the ideas it presents will be discussed throughout this thesis in relation to chaos theory. In particular, Beer’s idea that literature humanises and domesticates scientific ideas will formulate the basis of this discussion of the representation of chaos theory in literature.

The concept of deterministic chaos is fascinating to many authors and literary critics, but it is especially intriguing when it is applied to human behaviour and to the nonlinear dynamics of social systems. One of the defining characteristics of the literary appropriation of chaos theory is the way it locates what may be termed ‘human systems’ at the centre of chaos theory. By emphasising that chaotic dynamics determine the outcomes of social systems described in fictional narratives, literature domesticates chaos theory in precisely the same way that it has domesticated evolutionary theory. Comparing the literary reception of chaos theory and Darwinian evolutionary theory is useful in drawing attention to one of the defining characteristics of literature: its interest in and appropriation of ideas and values from different cultures, disciplines, and discourses.

Western literature demonstrates a sustained history of interest in science and examples are common: the Romantic poets refer to (what was to them) the new science of geology; nineteenth-century authors examine Darwinian evolutionary theory; and modern authors discuss relativity, quantum physics, and medical science.⁴¹ The discourse of science is continually of interest to literature because it embodies themes that transgress the temporal boundaries of specific literary movements and epochs. The literary appropriation of chaos theory is an indicator of two key literary-historical threads: literature’s interest in the theme of chaos, and literature’s interest in

⁴⁰ Neil Forsyth, “Chaos is come yet again,” a review of *Strange Attractors: Literature, Culture and Chaos Theory*, by Harriett Hawkins, in *Milton Review*, Volume 11, 1997. www.richmond.edu/~creamer/mr11.html (14 Jan 1998). See Hawkins, *Strange Attractors: Literature, Culture, and Chaos Theory*, New York: Prentice Hall/Harvester Wheatsheaf, 1995.

⁴¹ For an example see the following texts: *Charles Darwin’s The Origin of Species: New Interdisciplinary Essays*, edited by David Amigoni and Jeff Wallace, Manchester: Manchester University Press, 1995; and *Murdering to Dissect: Frankenstein, Grave-Robbing and the Anatomy Literature*, by Timothy Marshall, Manchester: Manchester University Press, 1996.

contemporary science. The historical continuity of literature's interest in science suggests that there is nothing unusual about the postmodern literary interest in chaos theory.⁴²

The importance of metaphor in scientific writing is also examined by James J. Bono in "Science, Discourse, and Literature: The Role/Rule of Metaphor in Science" (1990). Bono argues that metaphors are an integral feature of all scientific discourse, but adds that individual scientific disciplines place differing levels of emphasis on its importance. The literary interpreters of chaos theory suggest that the emphasis placed on metaphorical language is one indicator of difference between 'classical' or modern science and the postmodern science of chaos theory. Bono states that "[a]s a specialized and socially restricted discourse, the language of [classical] science does not... risk unwieldy, and unruly, dissemination of meaning."⁴³ Classical science presumes that metaphors introduce "inappropriate, nonliteral meanings into science, contaminating the precise and stable meanings science attempts to discover behind the terms it uses."⁴⁴ It operates on a model of information conservation: strictly controlling the production of meaning by restricting the use of metaphorical language. Conversely, chaos theory operates on a model of information proliferation whereby new ideas are disseminated through popular texts that make extensive use of metaphorical language.

Bono proposes that "science needs a nonliteral dimension" because restricting scientific discourse to only literal interpretations "of the terms and concepts of scientific theories impoverishes and disempowers them."⁴⁵ Bono argues that "metaphorical aspects of language are essential to understanding the dynamic of conceptual change in science precisely because they ground complex scientific texts and discourses in other social, political, religious, or 'cultural' texts and discourses."⁴⁶ Chaologists like Prigogine are aware that the discourse of science is dependent on the language of literature to express itself. Prigogine and Stengers agree with Bono that science needs metaphors to produce meaning and quote Erwin Schrödinger, a pioneer of the science of indeterminism, to

⁴² The nature of these two threads will be discussed in Chapter One.

⁴³ James J. Bono, "Science, Discourse, and Literature: The Role/Rule of Metaphor in Science," in *Literature and Science: Theory and Practice*, edited by Stuart Peterfreund, Boston: Northeastern University Press, 1990, pp. 59-89, p. 60.

⁴⁴ *Ibid.*, p. 62.

⁴⁵ *Ibid.*, p. 66. Bono refers to W. H. Leatherdale's *The Role of Analogy, Model, and Metaphor in Science*, Amsterdam: North-Holland, 1974, pp. 201-7.

⁴⁶ Bono, "Science, Discourse, and Literature," p. 61.

support their argument. Schrödinger claims in “Are there Quantum Jumps?” (1952) that “scientific findings, even those which at the moment appear the most advanced and esoteric and difficult to grasp, are meaningless outside their cultural context.”⁴⁷

Further support for the idea that metaphors are essential to science is provided by the psychologist F. Verhulst, who describes metaphors in “Metaphors for Psychoanalysis” (1994) as “qualitative models” that are particularly suited to studying systems where “a quantitative approach does not make much sense.”⁴⁸ In contrast to modern science’s emphasis on a rigorous, quantitative, methodology, literary critics predominantly adopt a qualitative methodology. They do not count the number of intimate encounters in D. H. Lawrence’s *Lady Chatterley’s Lover*; rather, they examine the significance of sexual relationships that breach social taboos. The quantitative versus qualitative debate is not fundamental to the two cultures divide as it applies to chaos theory for, as the psychologist Karl H. Pribram argues in “Chaos Edge” (1996), whether the application of chaos theory is quantitative and “data driven” or qualitative and “speculative,” there is “real substance” to its use in examining the properties of complex systems regardless of the specific context in which these systems are studied.⁴⁹

Not all scientists agree with these arguments. It has been common practice in scientific writing to deride the use of metaphorical language on the grounds that it threatens science’s objectivity. Scientific responses to the literary and cultural interest in science have been conditioned by the belief that the ‘objective’ enterprise of science is (and must remain) distinct from subjective social and political forces. Hayles argues in her Introduction to *Chaos and Order* that “so strong is the ideology of scientific objectivity that practitioners and laymen alike often speak as if scientists were hermetically sealed within the laboratory.”⁵⁰ She suggests in *Chaos Bound* that some scientists criticise, to use the words of Jeffrey S. Wicken, the use of “loose language” which allows scientific concepts to be understood and applied by those who have not

⁴⁷ Erwin Schrödinger, quoted by Prigogine and Stengers in *Order out of Chaos*, p. 18. See Schrödinger, “Are there Quantum Jumps?” in *The British Journal for the Philosophy of Science*, Volume 3, 1952, pp. 109-10.

⁴⁸ F. Verhulst, “Metaphors for Psychoanalysis,” in *Nonlinear Science Today*, Volume 4, No. 1, 1994, pp. 1-5. www.springer-ny.com/nst/vol4_no1a.pdf (28 Jun 1996).

⁴⁹ Karl H. Pribram, “Chaos Edge,” in *Nonlinear Dynamics in Human Behavior*, edited by William Sulis and Allan Combs, Studies of Nonlinear Phenomena in Life Science Series Volume 5, Singapore: World Scientific, 1996, pp. v-x, p. x.

⁵⁰ Hayles, *Chaos and Order*, p. 4.

contributed to their creation.⁵¹ According to Hayles, therefore, it is evident that metaphors “directly threaten science’s ability to separate its ideas from the language it uses to express them.”⁵² The ideology of objectivity maintained by modern science is challenged by the literary appropriation of chaos theory in two ways. Firstly, critics argue that science is as unable to distance itself from the subjective metaphorical language it uses as literature is, and therefore that its objectivity is fundamentally compromised. Secondly, critics point out that much of the literary appropriation of chaos theory is based on readings of popular chaos theory texts written not by journalists or science writers but by influential scientists.

The manipulation of metaphorical language is central to the literary use of chaos theory and science’s opposition to it. Sadie Plant argues in “The Virtual Complexity of Culture” that chaos theory is “leaking” out of science despite attempts by scientists critical of its literary use - like Paul R. Gross and Norman Levitt, authors of *Higher Superstition: The Academic Left and Its Quarrels with Science* (1994) - to contain its “leaky metaphors.”⁵³ Scientists like Gross and Levitt have criticised the literary interpretation of chaos theory for misinterpreting science and for attacking its methodological and ideological values. To these scientists, the literary use of chaos theory is unauthorised and unwarranted. The unauthorised nature of the literary use of chaos theory does not, however, deter critics. Hayles argues that when concepts like chaos become “highly charged” in contemporary culture that their use cannot be restricted to “authorized versions” - they are explored and exploited without the sanctioning of the established owners of the discourse in question.⁵⁴ This is what has occurred in the case of the literary appropriation of chaos theory. This thesis will examine some of the consequences of these circumstances.

⁵¹ Hayles, *Chaos Bound*, p. 50. See Jeffrey S. Wicken, “Entropy and Information: Suggestions for a Common Language,” in *Philosophy of Science*, Volume 54, 1987, pp. 176-93, p. 183.

⁵² Hayles, *Chaos Bound*, p. 50.

⁵³ Sadie Plant, “The Virtual Complexity of Culture,” in *FutureNatural: Nature, Science, Culture*, edited by George Robertson, *et. al.*, London: Routledge, 1996, pp. 203-17, p. 203; and Paul R. Gross and Norman Levitt, *Higher Superstition: The Academic Left and Its Quarrels with Science*, Baltimore: John Hopkins University Press, 1994, p. 99.

⁵⁴ Hayles, *Chaos Bound*, p. 116.

THE TEXTS

Hayles asserts in her Introduction to *Chaos and Order* that “it is a mistake to assume that the science of chaos has initiated the attitudes that have made it an object of popular fascination.”⁵⁵ This statement is not strictly correct, for the literary interest in chaos theory has only been partially initiated by chaos theory texts. Nonetheless, it is important because it draws attention to the fact that much of the interest in chaos theory has been initiated from within literature itself. It is essential to closely examine the literary texts that have contributed to the emergence of chaos as a particular concern within contemporary culture in order to comprehend the significance of scientific ideas for literature. Postmodern narrative fictions provide a clear point of reference from which to examine the cultural impact of chaos theory, but they should not be considered merely a site wherein interest in chaos theory is inscribed: they are also essential catalysts of the interest in chaos theory. It is imperative that the impact of these novels on the literary appropriation of chaos theory is carefully considered for, as Hayles argues in *Chaos Bound*, “literary texts [are] more concerned than either chaos theory or deconstruction with the aura of cultural meanings that surrounds chaos.”⁵⁶

Novels provide a nexus between the popular texts that explain chaos theory to a general audience and the critical texts that assess its impact on literature and culture by interpreting and re-inscribing the ideas contained in these popular texts. The novels that will be discussed in this thesis represent a variety of genres, including literary, popular, and science fictions. No particular strategy has been employed to determine which texts will be discussed. In order to consider the literary impact of chaos theory as fully as possible within the limited scope of this thesis, distinct fictions and disparate theoretical works have been brought together for the purpose of critical analysis. This thesis will not pay significant attention to traditional interpretative concepts such as plot, character, and theme. Instead, it will adopt an interpretative style that embraces texts as containers of multiplicitous information: thus opening novels to readings that focus on specific issues,

⁵⁵ Hayles, *Chaos and Order*, p. 5.

⁵⁶ Hayles, *Chaos Bound*, 19.

like chaos, instead of examining the sum of the ideas they contain in equal depth. This style may be labelled opportunistic, but its use is necessary in these circumstances in order to establish the study of the literary domestication of chaos theory.

Several of the novels that will be examined here, including Italo Calvino's *If on a Winter's Night a Traveler* (1979), Milan Kundera's *The Unbearable Lightness of Being* (1984) and Don DeLillo's *White Noise* (1986), have already received considerable critical attention. However, the subject of chaos has been largely overlooked in previous readings of these texts; a deficiency that will be addressed here. Novels that are not so well known, or which have received little critical attention, will also be considered: George C. Foster's *The Change* (c. 1970), Tim O'Brien's *The Nuclear Age* (1987), Michael Crichton's *Jurassic Park* (1991), Robert Littell's *The Visiting Professor* (1994), and Iva Pekárková's *Truck Stop Rainbows* (1994).⁵⁷ Given the scientific nature of chaos theory, it is not surprising that some of its fictional representations are contained in science fictions. However, it is equally true that many chaos theory novels are clearly not science fictions. In "Art and Science in Chaos: Contesting Readings of Scientific Visualisation" (1994) Richard Wright suggests that a "common way for scientific ideas to be mediated into popular culture has been through science fiction, but ... this does not seem to have happened in the case of Chaos theory."⁵⁸ Only four of the nine novels listed above are science fictions. A peculiarity of the literary and cultural use of chaos theory is that it is not limited to the genre of science fiction, but is perpetuated through a variety of genres.

The issue of distinguishing between implicit and explicit representations of chaos theory will not be considered at length here because such analysis is inadequate to explain the literary implications of chaos theory, which differ significantly from novel to novel. To give an example, whereas *Jurassic Park* explicitly defines chaos theory as its theme and employs its metaphors accordingly, *White Noise* and *The Unbearable*

⁵⁷ *The Change* and *Jurassic Park* are popular science fictions, and have been overlooked for this reason. Discussions of *Jurassic Park* are primarily related to Stephen Spielberg's cinematic adaptation of Crichton's novel. The simplicity of Spielberg's film overwhelms and subverts the complexities of Crichton's text, reducing the importance of chaos theory in favour of the dinosaurs. *The Visiting Professor* and *Truck Stop Rainbows* were published relatively recently; there has been insufficient time for a critical response to develop. The case with *The Nuclear Age* is different: it has received almost no attention, despite O'Brien's reputation and its postmodernist pretensions.

⁵⁸ Richard Wright, "Art and Science in Chaos: Contesting Readings of Scientific Visualisation," in Proceedings of the 1994 ISEA Conference. uah.fi/bookshop/isea_proc/nextgen/14.html (15 Oct 1996).

Lightness of Being incorporate chaos theory metaphors implicitly, without openly acknowledging their scientific origins. Despite significant differences between their applications of chaos metaphors, these texts indicate that such metaphors are central to both science and literature. Assessing the differences between explicit and implicit references to the concepts of chaos theory may enable critics to gauge whether chaos theory is of interest to only a few writers, or a theme that has become deeply enmeshed in contemporary culture, it provides only a partial confirmation of the premise forwarded by Hayles and others: that chaos theory is becoming increasingly influential in the humanities.

The more important issue is to consider what effect chaos theory is having on literature: to reflect on how chaos theory is being assimilated into literature, and for what purposes. Beer points out in *Darwin's Plots* that "the question of who read Darwin, or whether a writer had read Darwin, becomes only a fraction of the answer" to the question of the extent of the influence of Darwin's ideas.⁵⁹ She suggests that the real measure of the influence of a scientific idea on literature is to question how this idea has become entrenched within texts. The extent of chaos theory's influence on literature should be measured through the multiplicitous and ambiguous references to chaos theory that litter novels as well as their more obvious allusions to it. The hypothesis that will be forwarded here is that by the time of the publication of Gleick's *New Science* in 1987 the principles of chaos theory had become so enmeshed in postmodern culture that differences between implicit and explicit references to it have become all but immaterial.

The popular texts of chaos theory, such as *New Science* and Prigogine's and Stengers' *Order out of Chaos*, are obvious catalysts of the literary and cultural interest in chaos theory.⁶⁰ These texts vary considerably in terms of their focus and tone. What they share, for the most part, is an abiding interest in defining the history of chaos theory and the personalities of its leading protagonists. The history of chaos theory that emerges

⁵⁹ Beer, *Darwin's Plots*, p. 6.

⁶⁰ Other influential examples of the genre include James E. Lovelock's *Gaia: A New Look at Life on Earth*, Oxford: Oxford University Press, 1979; Stewart's *Does God Play Dice?*; Roger Lewin's *Complexity: Life at the Edge of Chaos*, New York: Macmillan, 1992; Edward N. Lorenz's *The Essence of Chaos*, London: University College London (UCL) Press, 1993; M. Mitchell Waldrop's *Complexity: The Emerging Science at the Edge of Order and Chaos*, London: Penguin, 1994; John L. Casti's *Complexification: Explaining a Paradoxical World Through the Science of Surprise*, London: Abacus, 1994; Peter Coveney's and Roger Highfield's *Frontiers of Complexity: The Search for Order in a Chaotic World*, New York: Fawcett Columbine, 1995; and Richard Leakey's and Roger Lewin's *The*

from these texts is a narrative of ambiguous authenticity which contains more than a historical record: it incorporates exaggerated descriptions of the characteristics and achievements of selected chaologists, and therefore (either incidentally or deliberately) distorts the history of chaos theory. The scientific narration of chaos theory further conflates the scientific and cultural contexts of chaos theory, especially when the similarities between fictional and non-fictional popular chaos theory narratives are considered. Without these texts, however, neither the critical nor the fictional texts that encompass the literary interpretation of chaos theory could have evolved.

The final group of texts that will be examined here - those that comprise the critical interpretation of chaos theory - are as much evidence of the interest in chaos theory as novels like *Jurassic Park*. In addition to Hayles' *Chaos Bound* and the essays in *Chaos and Order*, this group of texts includes Jean-François Lyotard's *The Postmodern Condition: A Report on Knowledge* (1984), and Jean Baudrillard's *The Transparency of Evil: Essays on Extreme Phenomena* (1993) and *The Illusion of the End* (1994).⁶¹ These texts are analogous to popular chaos theory texts in that they are significantly motivated by political concerns, espousing different and sometimes conflicting agendas and employing distinct strategies to interpret and apply the principles of chaos theory to social systems. They also represent a consciously critical response to chaos theory, rather than the unquestioned adoption of its ideas.⁶²

Many popular chaos theory texts outline the etymology of chaos and the history of the concept in western society, which begins with mythological accounts of the creation of an ordered world from a 'chaos' of unformed, undifferentiated matter. In *Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness* (1989) John Briggs and F. David Peat argue that ancient Chinese, Egyptian, Babylonian, and Greek civilisations all established the concept of chaos, but that the Greek idea of

Sixth Extinction: Biodiversity and its Survival, London: Pheonix, 1996.

⁶¹ Further examples include William R. Paulson's *The Noise of Culture: Literary Texts in a World of Information*, Ithaca: Cornell University Press, 1988; Paisley Livingston's *Literary Knowledge: Humanistic Inquiry and the Philosophy of Science*, Ithaca: Cornell University Press, 1988; Alexander J. Argyros' *A Blessed Rage for Order: Deconstruction, Evolution and Chaos*, Ann Arbor: University of Michigan Press, 1991; and Hawkins' *Strange Attractors*.

⁶² There is a strong degree of interest in chaos theory from German-speaking scholars. This area of literature will not be examined in this thesis, but I am grateful to John McCarthy for bringing it to my attention. See for example Julie A. Reahard, *Chaos Theory, Hermeneutics and Goethe's Die Wahlverwandtschaften*, Internationale Forschungen zur Allgemeinen und Vergleichenden Literaturwissenschaft 25, Amsterdam/Atlanta: Rodopi, 1997.

chaos has had the greatest impact on western culture.⁶³ Hesiod's mythological text *Theogony* has been acknowledged as containing the oldest known definition of chaos.⁶⁴ From its mythological origins, chaos developed literary, philosophical, and scientific connotations; the pre-Socratic Greek philosophers established the concept of 'flux' or chaotic change as an important part of their worldview, and developed assumptions about the role of chaos in nature that continue to inform scientific practice and literary speculation. Greek ideas about chaos informed Jewish and Christian mythologies, and contributed significantly to the representation of chaos in the Bible.⁶⁵

The influence of chaos theory on contemporary literature is often defined in mythological terms. Beer suggests in *Darwin's Plots* that scientific discourses always contain mythological remnants, and that literary criticism is useful in revealing the mythological connotations of scientific ideas.⁶⁶ She argues that "Darwinian theory takes up elements from older orders and particularly from recurrent mythic themes such as transformation and metamorphosis."⁶⁷ This is also the case with chaos theory, which manifests its reliance on the mythological concept of chaos and on cultural definitions of order and disorder. Marc Fonda argues in "Postmodernity and the Imagination of the Apocalypse: A Study of Genre" (c 1996) that "it is our predilection [in western culture] to make myths, to imagine our world in mythic themes."⁶⁸ Chaos theory defines a scientific worldview which conforms to this form of cultural imagining. In "Making Chaos" Porush argues that Gleick's *New Science* establishes chaos theory as a

⁶³ John Briggs and David F. Peat, *Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness*, New York: Harper and Row, 1989, p. 19. For a brief discussion of the etymology of chaos see Hayles' Introduction to *Chaos and Order*, pp. 2-3. For a discussion of conceptions of chaos in Egyptian, Mesopotamian, and other ancient cultures see Norman Cohn, *Cosmos, Chaos, and the World to Come*, London: Yale University Press, 1993.

⁶⁴ Hesiod, *Theogony*, translated by Apostolos N. Athanassakis, Baltimore: Johns Hopkins University Press, 1983. Hayles in *Chaos and Order* and Prigogine and Stengers in *Order out of Chaos* both identify Hesiod as the first to define chaos as the progenitor of the universe, the partner not opposite of order. See Hayles, *Chaos and Order*, p. 14; Prigogine and Stengers, *Order out of Chaos*, p. 38.

⁶⁵ The Greek concept of chaos is represented throughout western literature, including John Milton's "Paradise Lost," which, according to A. B. Chambers, represents chaos as the primary matter of the universe from which all God creates the world. Milton's definition of chaos is similar to that of the ancient Greeks, primarily because the Greek definition of chaos informed the Biblical conception of chaos, which was one of Milton's major points of reference. See Chambers, "Chaos in 'Paradise Lost,'" in *Journal of the History of Ideas*, Volume 24, 1963, pp. 55-84; see also Hayles, *Chaos Bound*, p. 19.

⁶⁶ Beer, *Darwin's Plots*, p. 4.

⁶⁷ *Ibid.*, p. 9.

⁶⁸ Marc Fonda, "Postmodernity and the Imagination of the Apocalypse: A Study of Genre." www.strangelove.com/~marc/dragon.html (21 Oct 1996).

“postmodern mythology.”⁶⁹ Contemporary culture mythologises and domesticates chaos theory by appropriating it through literature. Hayles suggests in *Chaos Bound* that “both scientific and literary discourses are being distinctively shaped by a reevaluation of chaos.”⁷⁰ Harriett Hawkins suggests in *Strange Attractors: Literature, Culture, and Chaos Theory* that this occurrence is significant because “it is very unusual for the insights of modern experimental sciences to resonate with primal mythic fictions.”⁷¹ When science acknowledges the influence of a subjective, cultural force like chaos, a meaningful event in the relationship between science and the humanities has occurred.

THE CHAPTERS

This thesis may be distinguished from other examinations of the literary impact of chaos theory in three notable ways. Firstly, it differs from other critiques by the way it treats fictional, theoretical, and popular chaos theory texts: no other critique considers these texts as equal catalysts of the literary interest in chaos theory. Its second point of difference is that instead of competing with other critical texts, this thesis will assess as many examples of the literary use of chaos theory as possible in order to unravel its historical, political, and theoretical foundations: it will develop a meta-critique of the literary interpretation of chaos theory by examining its most significant texts, considering their similarities and differences, and reflecting on the strategies they employ to interpret and apply its principles. Many critics do not comment on the breadth of the literary use of chaos theory - they focus on specific depths - and comparisons that would further this literary project are often not made. This thesis aims to fill some of these gaps.

The third distinctive feature of this thesis is its focus on recent representations of chaos in literature. The project of analysing chaos theory’s impact on literature focuses mainly on postmodern texts, but some critics have used it to examine earlier texts, including the poetry of John Milton and William Blake and the novels of James Joyce.⁷²

⁶⁹ David S. Porush, “Making Chaos: Two Views of a New Science,” in *The Literature of Science: Perspectives on Popular Scientific Writing*, edited by Murdo William McRae, Athens: University of Georgia Press, 1993, pp. 152-68, p. 153.

⁷⁰ Hayles, *Chaos Bound*, p. 177.

⁷¹ Hawkins, *Strange Attractors*, p. 6.

⁷² There are numerous examples of texts that examine modern and pre-modern literature in relation to

In *Strange Attractors* Hawkins discusses the mythological and scientific connotations of chaos in the texts of John Milton, William Shakespeare, and Michael Crichton. In relation to the issue of applying chaos theory to interpret pre-modern texts, she comments that “the mutuality of insight operates retroactively as well as reciprocally, so that portrayals of deterministic chaos in current works based on modern science lend new relevance to past works, just as past works lend their mythic force to present works.”⁷³ The wider literary application of chaos metaphors will not be considered here: this thesis is only concerned with texts produced in the ‘postmodern era.’ The principal difference between studying representations of chaos in pre-modern and modern texts and in postmodern texts is that analysis of the former cannot be considered causally in relation to the science of chaos, whereas the representation of chaos in contemporary texts can be considered on both metaphorical and causal levels.

This thesis is divided into two main sections. The first section is concerned with assessing literature’s critical interest in chaos theory and how this has been received by science. The second section is concerned with the representation of chaos theory in a select set of novels, with the ways in which novels exploit chaos theory principles and how they contribute to and reflect the values of the critical and theoretical texts examined in the first two chapters. Within these two sections, each chapter is designed to fulfil a particular function in relation to the three aims of this thesis: to examine the critical literary use of chaos theory, to examine its representation within novels, and its advancement of a meta-critique of the literary use of chaos theory. It is important to recognise that while this thesis is concerned with the discourse of chaos theory and the ideas it encapsulates, the ‘hard’ science of chaos theory itself is not of primary concern here: examining how western literature has responded to scientific conceptualisations of chaos, order, and disorder is the fundamental aim of this thesis.

chaos theory. See for example Michael A. Schwartz, “‘Eternal Fires’: Chaotic Systems and Blake’s Mythology.” prometheus.cc.emory.edu/panels/3A/M.Schwartz.html (8 Oct 1996); Philip Kuberski, *Chaosmos: Literature, Science, and Theory*, Albany: State University of New York Press, 1994; Thomas Jackson Rice, *Joyce, Chaos and Complexity*, Chicago: University of Illinois Press, 1997, and “Ulysses, Chaos, and Complexity,” *Hypermedia Joyce Studies* 1.1 (1995).

astro.temple.edu/~callahan/hjs/framed/rice.html (23 Jan 1997) (Note: This article originally appeared in a slightly different form in the *James Joyce Quarterly* 31.2 (1994): 41-54); and Ira Livingston, *Arrow of Chaos: Romanticism and Postmodernity*, Minneapolis: University of Minnesota Press, 1997.

⁷³ Hawkins, *Strange Attractors*, p. 7.

Chapter One contains essential introductory material concerning the development of chaos theory as an area of scientific enquiry, and discusses the nature of literature's interest in science from a historical perspective. This chapter will also discuss the literary concern with mythological and philosophical ideas, including the mythological origins of the concept of chaos. This chapter aims to complement rather than compete with similar literary introductions to chaos and chaos theory contained in various contemporary texts; the breadth of literary opinions in relation to chaos theory is in itself a burgeoning topic, and one that this thesis attempts to encourage.

Chapter Two will discuss appropriations of chaos theory advanced by N. Katherine Hayles, Jean-François Lyotard, and Jean Baudrillard. These critics do not form a united group, or operate as a school: their respective applications of chaos theory are the product of parallel but distinct interpretative processes. Two related but distinct aspects of their use of chaos theory may be identified: firstly, their interpretation or 'transvaluation' of its principles into literary discourse; and, secondly, their application of these principles to social and fictional systems. Although this chapter will only examine a few of the many critical interpretations and applications of chaos theory, it will outline some of the key features of this literary project and will comment on its most important characteristics.

Chapter Three will examine the politics of chaos theory as they affect and influence its literary interpretation. Differences between scientists who claim ownership of chaos theory and critics who aim to share its epistemological authority have resulted in a fervent debate between science and the humanities concerning the epistemological validity of literary uses of scientific ideas and of postmodernism. The motivations that drive the interpreters of chaos theory and the scientists who critique this will be discussed. The backlash is characterised by a fervent 'counter-critique' which attacks the theoretical and epistemological foundations of literary uses of chaos theory. Prominent examples of the counter-critique include Gross' and Levitt's *Higher Superstition, The Flight from Science and Reason* (1996), edited by Gross, Levitt, and Martin W. Lewis, and Alan D. Sokal's "Transgressing the Boundaries: Towards a Transformative

Hermeneutics of Quantum Gravity” (1996), which satirically deconstructs postmodern theoretical practices and its appropriative strategies.⁷⁴

Chaos theory principles such as ‘the butterfly effect,’ ‘eternal return’ or ‘recursive symmetry,’ and ‘the edge of chaos’ will be discussed alongside existing scientific ideas that chaos theory relies on, such as the Second Law of Thermodynamics and information theory, in Chapter Four to introduce a discussion of Milan Kundera’s *The Unbearable Lightness of Being* and Italo Calvino’s *If on a Winter’s Night a Traveler*. These novels characterise the variety of fictional texts that incorporate references to chaos theory, and demonstrate that far from being a concern that is limited to one genre, the literary appropriation of chaos theory is prevalent throughout fictional genres.

Chapter Five will investigate the chaotic dynamics of complex environmental systems as they are represented in *Jurassic Park*, *Truck Stop Rainbows*, *The Nuclear Age* and *The Change*. The concept of collapse, which defines how complexly ordered systems collapse into disorder, features in all these texts. Chaos theory has been adopted by anthropologists and other social scientists to formulate a new philosophy of catastrophism which delves into the chaotic causes of social events, and this interpretation of chaos theory will be used to elucidate the catastrophes represented in these novels. Collapse is signified in contemporary novels by technological forces like biological engineering and nuclear pollution which are capable of comprehensively destabilising human society. Zimmerman argues in *Contesting Earth’s Future* that “a chaos-generated future may be far more like a dystopian technological nightmare than the ectopian world of radical ecologists.”⁷⁵ *Jurassic Park*, *The Change* and *The Nuclear Age* all demonstrate that chaotic perturbations encourage the occurrence of dystopian events and therefore have dangerous implications for human civilisations.

The Sixth and final chapter will propose a psychological interpretation of chaos and examine its antithesis: the interpretation of narrative chaos as farce. Toffler suggests in his Foreword to *Order out of Chaos* that the application of chaos theory to

⁷⁴ Gross, Levitt and Martin W. Lewis, eds., *The Flight from Science and Reason*, Annals of the New York Academy of Sciences, Volume 775, New York: New York Academy of Sciences, 1996; and Alan D. Sokal, “Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity,” in *Social Text*, Volume 46/47, 1996, pp. 217-52.

www.physics.nyu.edu:80/faculty/sokal/transgress_v2/transgress_v2_singlefile.html (19 Feb 1997).

⁷⁵ Zimmerman, *Contesting Earth’s Future*, p. 326.

psychology has culminated in a new interpretation of chaotic psychological processes.⁷⁶ This chapter will consider the possibilities of the integration of chaos theory and psychology for literature. For the sake of the argument presented here, it will be maintained that fictional characters possess the same types of psychological conditions as living people, and that their behaviour can be analysed with reference to the same theoretical concepts. In “Getting the Story Straight: Narrative and Historical Knowledge” (1994) David Carr proposes that narratives do not differ “in form or structure from the ‘real world’” - they are fundamentally “an extension and refinement” of the very form and structure of the reality which they represent.⁷⁷ Consequently, the ideas and relationships they represent do not differ fundamentally from those that exist in ‘reality.’

Paisley Livingston argues in *Literary Knowledge: Humanistic Inquiry and the Philosophy of Science* (1988) that the “psychological insights” of narratives are worthy of critical attention because they “offer a set of initial assumptions and models [of the world] far superior” to those of “orthodox” disciplines like economics.⁷⁸ In *White Noise*, for example, characters cope badly with chaotic events and become confused, frightened, and irrational. In contrast to chaos psychology’s bleak impression of the human condition, an interpretation of chaos as farce, which will draw attention to the parodic characteristics of novels that encode chaos, will also be considered here. *The Visiting Professor* and *Jurassic Park* satirically deconstruct chaologists’ personalities and parody their ideas and eccentricities and by making informed references to popular chaos theory texts which represent the chaologist as a stereotypical ‘mad scientist.’ Analysis of these texts is crucial in establishing a critical understanding of literature’s interpretation of chaos theory, and in demonstrating the extent to which literature is involved in the popularisation of chaos theory.

⁷⁶ Toffler, Foreword to *Order out of Chaos*, p. xxiv.

⁷⁷ David Carr, “Getting the Story Straight: Narrative and Historical Knowledge,” in *Historiography Between Modernism and Postmodernism: Contributions to the Methodology of the Historical Research*, edited by Jerzy Topolski, Amsterdam: Rodopi, 1994, pp. 119-133, p. 120.

⁷⁸ Livingston, *Literary Knowledge*, p. 198.