THE APPROPRIATION OF CHAOS THEORY

This chapter will introduce the texts that represent the literary appropriation of chaos theory and will establish a critical analysis of their accomplishments. The three theorists whose ideas will be discussed here - N. Katherine Hayles, Jean-François Lyotard, and Jean Baudrillard - have arguably contributed the most to advancing a postmodern cultural perception of chaos theory. N. Katherine Hayles discusses chaos theory predominantly in relation to Jacques Derrida, Roland Barthes, and Michel Serres in *Chaos Bound*. This chapter will therefore focus on other discussions of the convergence of chaos theory and postmodernism contained in Hayles' own texts and those of two other influential theorists: Jean-François Lyotard's *The Postmodern Condition: A Report on Knowledge* and several of Jean Baudrillard's texts including *The Transparency of Evil: Essays on Extreme Phenomena*. This chapter is divided into three sections: each will focus on the work of one critic; the summary that follows will incorporate some comparative remarks.

An initial assessment of these texts suggests that their aim is to promote and establish a synthesis of chaos theory and postmodern theory, but this homogenising view ignores the substantial differences that exist between them. Hayles, Lyotard, and Baudrillard share in intense interest in science, but the extent to which their perceptions of chaos theory converge is less obvious. To give an example of their differences, Lyotard and Hayles agree that through the convergent paradigms of chaos theory and postmodernism critics and chaologists have influenced each others' worldviews. In contrast, Baudrillard makes a point of obscuring chaos theory's scientific origins: he does not acknowledge that chaos theory and postmodernism have influenced each other and instead forwards the view that chaos theory is entrapped in the matrix of postmodern discourse and has no origins. These differences have complicated and slowed chaos theory's reception in literature and cultural studies, and have made it impossible to

consider the literary interest in chaos theory as a consistent phenomenon. When the motives of these critics are considered individually, generalisations about the nature of their interpretations are revealed to be unhelpful, for they do not account for the extent or implications of their differences. What is required is a reasoned analysis of their individual contributions to the literary interpretation of chaos theory. Only when these views have been examined can an inclusive overview of this phenomenon be established.

The first section of this chapter will evaluate Lyotard's interpretation of nonlinear science in *The Postmodern Condition: A Report on Knowledge*. Lyotard's interpretation is based primarily on René Thom's catastrophe theory, a precursor of chaos theory, and on ideas established by the chaologists Edward Lorenz and Ilya Prigogine and the founder of fractal geometry, Benoit Mandelbrot. As the first text to discuss nonlinear science in a cultural context, *The Postmodern Condition* represents a pivotal development in the cultural understanding of chaos theory, and has deeply influenced Hayles and Baudrillard as well as impacting upon Lyotard's more recent writings, including *The Inhuman: Reflections on Time*. *The Postmodern Condition* is remarkable in that it assesses the implications of nonlinear science for contemporary culture even before nonlinear science had fully developed into the paradigm of chaos theory. One particular feature of *The Postmodern Condition* that will be discussed here is its focus on paradoxes: Lyotard argues that in studying paradoxical ideas like deterministic chaos, science has instituted a fundamental change in knowledge and in its worldview.

The second section will discuss the work of Hayles, who has arguably accomplished more than other critic in evaluating the literary implications of chaos theory. Two major themes of Hayles' work will be considered here. The first is Hayles' comparison of chaos theory with deconstruction, which is central to the literary project of reading texts in relation to chaos theory: it provides an established theoretical perspective from which to approach the representation of chaos in narratives, enabling critics to incorporate the principles of chaos theory into their interpretative strategies more easily than if they had to develop understandings of these principles independently. The second theme of Hayles' work that will be considered here is her critique of the legitimacy and epistemological authority of the literary use of chaos theory. Hayles is ambivalent about the implications of chaos theory for the humanities; while she celebrates its innovative properties, she also recognises that it has the potential to

develop into what Lyotard would describe as a 'grand narrative,' and that its application to literary criticism may be inconsistent with some of the characteristics of postmodernism.

Jean Baudrillard's interpretation of chaos theory and his application of it to his theory of simulation and to historical systems will be examined in the third section. Baudrillard's contribution to the literary use of chaos theory is considerable, yet it has been overlooked by many of his critics. This section will examine the unique features of Baudrillard's interest in chaos theory and will consider why this has not been widely examined. The most important aspect of Baudrillard's interpretation of chaos theory is his epistemology of indeterminism. Baudrillard's historiography is consistent with other recent historiographical perspectives informed by chaos theory. This complementarity suggests that Baudrillard's use of chaos theory represents a valuable contribution to its current application to social systems.

JEAN-FRANÇOIS LYOTARD

The postmodern philosopher Jean-François Lyotard examines various forms of cultural and scientific knowledge in *The Postmodern Condition* (1984), first published as *La Condition Postmoderne: Rapport sur le Savoir* (1979).[1] *The Postmodern Condition* is a significant text in the history of the cultural interest in chaos theory for two reasons. Firstly, it was the first cultural text to examine the science of nonlinear dynamical systems, which was in the process of evolving into the paradigm of chaos theory at this time. Secondly, *The Postmodern Condition* significantly influenced later literary and cultural interpretations of chaos theory. Lyotard's perception of nonlinear science is founded primarily on catastrophe theory, which has since been incorporated into chaos theory, and on fractal geometry. Lyotard was influenced in his interpretation of nonlinear science by the catastrophe theorist René Thom's *Stabilité Structurelle et Morphogenèse: Essai d'une Theorie Générale des Modèles* (1972) and *Modèles Mathématiques de la*

[1] Lyotard, *The Postmodern Condition* (*La Condition Postmoderne: Rapport sur le Savoir*, Paris: Les Editions de Minuit, 1979).

Morphogenèse (1974),[2] the fractal theorist Benoit Mandelbrot's *Fractals: Form, Chance and Dimension* (1977),[3] and Ilya Prigogine's and Isabelle Stengers' "La Dynamique, de Leibniz à Lucrèce" (1979).[4] This section will examine Lyotard's interpretation of catastrophe theory as the nonlinear science of paralogy and consider how this interpretation has shaped the current interest in chaos theory.

Thom's catastrophe theory represents the mathematical contextualisation of an idea that was first given scientific validity in discussions of evolution and extinction in the eighteenth and nineteenth centuries. According to the palaeo-anthropologist Richard Leakey and the science writer Roger Lewin in *The Sixth Extinction: Biodiversity and its Survival* (1996) a scientific concept of catastrophe was developed by the French anatomist Baron Georges Cuvier in the late eighteenth century to account for the evidence of mass extinctions that scientists were beginning to discover.[5] Leakey and Lewin argue that:

> Cuvier lived in pre-evolutionary times, of course, and therefore saw the catastrophes as individual events that wiped out existing life, setting the stage for new waves of creation. The Noachim flood was said to have been one such event; the total number of crises was eventually estimated to have been about thirty. Cuvier's scheme came to be known as catastrophism.[6]

Catastrophism subsequently became unfashionable in the nineteenth century as the idea of gradual change took hold: the geologist Charles Lyell dismissed the idea of sudden change caused by environmental catastrophes as an appeal to "extraordinary agents"

[2] René Thom, *Modèles Mathématiques de la Morphogenèse*, Paris: Union Générale d'Edition, 1974 (see Lyotard, *The Postmodern Condition*, p. 4); and *Stabilitè Structurelle et Morphogenèse: Essai d'une Theorie Générale des Modèles*, Reading: W. A. Benjamin, 1972 (see Lyotard, *The Postmodern Condition*, p. 59).

[3] Benoit Mandelbrot, *Fractals: Form, Chance, and Dimension*, San Francisco: W. H. Freeman, 1977 (see Lyotard, *The Postmodern Condition*, p. 54).

[4] Prigogine and Stengers, "La Dynamique, de Leibniz à Lucrèce," in *Critique*, Volume 380, 1979, p. 49 (see Lyotard, *The Postmodern Condition*, p. 56). Prigogine's and Stengers' first French edition of *Order out of Chaos, La Nouvelle Alliance: Metamorphose de la Science*, was also published in 1979, slightly too late for Lyotard to discuss it in *The Postmodern Condition*. See Prigogine and Stengers, *La Nouvelle Alliance: Metamorphose de la Science*, Paris: Gallimard, 1979.

[5] Leakey and Lewin, *The Sixth Extinction*, p. 41. For a recent discussion of Cuvier's ideas, see Martin J. S. Rudwick, *Georges Cuvier, Fossil Bones, and Geological Catastrophes: New Translations and Interpretations of the Primary Texts*, Chicago: The University of Chicago Press, 1997.

[6] *Ibid*., p. 42.

rather than to scientific principles, and Charles Darwin argued that gradual rather than sudden change caused by natural selection best explained mass extinctions.[7]

Science's return to catastrophism in the late twentieth century has been prompted by the search for answers about the extinction of the dinosaurs. Leakey and Lewin describe the hypothesis that the impact of an asteroid contributed to the mass extinction of the dinosaurs as an example of this new catastrophism.[8] They suggest that "[t]he argument that major biotic crises are the result of a confluence of detrimental effects, perhaps including asteroid or comet impact, seems very reasonable"[9] and that the scientific reappraisal of Lyell's extraordinary agents "has ushered in a new catastrophism, one that encompasses forces outside normal human experience."[10] The principles of this new catastrophism are central to chaos theory, which draws upon the concept of extraordinary agents in the form of strange attractors, and which defines these attractors as scientific hypotheses rather than as extra-scientific forces.[11]

Catastrophe theory has become an essential part of chaos theory by defining the function of bifurcation points: the points in complex open systems where dramatic change occurs. John L. Casti suggests in *Complexification: Explaining a Paradoxical World Through the Science of Surprise* (1994) that Thom describes a catastrophe as an event where a system's behaviour switches from a stable attractor to an unstable one: from a fixed point or other linear attractor to a strange or chaotic attractor.[12] Catastrophe theory places emphasis on instability and change rather than on stability, and to Lyotard, this means that it "directly questions the validity of the notion of a stable

[7] Lyell, from *Principles of Geology*, quoted by Leakey and Lewin in *The Sixth Extinction*, p. 42.
[8] Leakey and Lewin, *The Sixth Extinction*, pp. 51-8.
[9] *Ibid*., p. 56.
[10] *Ibid*., p. 58. This new scientific catastrophism must be distinguished from the type of pseudo-scientific catastrophism that is used to confirm the historical accuracy of ancient events of religious significance. For an example of this type of catastrophism, see Ted Holden's "Catastrophism: The Emerging Science of Origins" page at www.access.digex.net/~medved/Catastrophism.html (10 Nov 1997).
[11] The dispute between catastrophists, who propose that sudden causes eliminated the dinosaurs, and 'gradualists' who prefer a neo-Darwinian model, is ongoing. See "What really killed the dinosaurs?" in *New Scientist*, 16 August 1997. www.newscientist.com/ns/970816/features.html (19 Feb 1998).
[12] Casti, *Complexification: Explaining a Paradoxical World Through the Science of Surprise*, p. 53.

system."[13] Lyotard is interested in the characteristics of unstable social systems, and uses catastrophe theory to draw out some of their features.

Lyotard's focus on catastrophism leads him to define the essence of a new form of science. He characterises catastrophe theory as typical of postmodern science, which he defines as "paralogy," a science based on difference, change and disorder. Lyotard then argues that the epistemology of the postmodern science of paralogy is distinctly different from the epistemology of modern science, and that the worldview of paralogy has developed because postmodern culture is undergoing a dramatic change in representational practices. This change in science's representational practices is characterised by the systematically undermining of the qualitative knowledge so valued by modern culture:

> Postmodern science - by concerning itself with such things as undecidables, the limits of precision control ... '*fracta*,' catastrophes and pragmatic paradoxes - is theorizing its own evolution as discontinuous, catastrophic, non-rectifiable, and paradoxical. It is changing the meaning of the word knowledge ... It is producing not the known, but the unknown. And it suggests a model of legitimation that has nothing to do with better performance, but has as its basis difference understood as paralogy.[14]

Lyotard's description of postmodern science as paralogy incorporates two of the primary characteristics of chaos theory: its focus on difference, catastrophe, fractals, and paradox, and its epistemology of indeterminism. For Lyotard, the change from deterministic to indeterministic worldviews brought about by catastrophe theory suggests that the "model of legitimation" of determinism is a manifestation of the grand narrative of enlightenment science that cannot be maintained in postmodern culture.

Benoit Mandelbrot's fractal theory provides another of the scientific foundations of Lyotard's interpretation of nonlinear science. Mandelbrot coined the terms "fractal" and "fractal geometry" and is considered the 'father' of fractal theory.[15] Fractal geometry delineates the fractional dimensions of chaotic systems, which cannot be adequately measured or mapped in relation to standard Euclidean geometry. Fractal images are visual representations of the nonlinear equations that define the behaviour of chaotic systems. The patterns in fractal images are highly sensitive to their initial conditions:

[13] Lyotard, *The Postmodern Condition*, p. 58.
[14] *Ibid*., p. 60.
[15] Hayles, *Chaos Bound*, p. 165. See Mandelbrot's *The Fractal Geometry of Nature*, revised edition,

when these parameters are changed, even slightly, changes ensue in the pattern. Fractal images are considered chaotic in that they are extremely sensitive to their initial conditions. Lyotard's use of the term 'fracta' is a direct reference to Mandelbrot, his fractal images, and the mathematical and scientific concepts that encapsulate fractal theory. From catastrophe theory and fractal theory Lyotard develops an impression of postmodern science that is fundamentally new in both its conception science and its explanation of how scientific principles relate to the human world. Lyotard initiates the domestication of chaos theory by describing how the principles of nonlinear science can be applied to social systems.

Two concepts are of particular concern to Lyotard: paradox and indeterminism. Lyotard's analysis of paradoxes is an important aspect of his interpretation of nonlinear science. He argues that twentieth century scientific discourse, which should be understood as a language-game rather than as straightforward empirical research, has given rise "to 'paradoxes' that are taken extremely seriously and to 'limitations' on the scope of knowledge that are in fact changes in its nature."[16] The phenomenon of deterministic chaos represents the paradoxical co-existence of randomness and determinism: a co-existence that science has thus far been unable to explain. Unlike linear systems, whose future behaviour can be accurately predicted, the behaviour of nonlinear systems is difficult to predict. The paradox of deterministic chaos destabilises science's ability to predict events, and thus constitutes a limit on modern science's epistemological power. Whereas chaos as random disorder simply negates determinism, deterministic chaos destabilises determinism without rejecting it. Lyotard's account of modern science's inability to predict the behaviour of complex systems fundamentally undermines its determinist methodology, and represents a change in the very nature and purpose of science.

Lyotard's application of the principle of indeterminism to historical and social systems allows him to hypothesise that prediction in the postmodern world has become impossible. Lyotard does this by hypothesising in *The Postmodern Condition* about "the

New York: W. H. Freeman and Company, 1983; and *Fractals: Form, Chance, and Dimension*.

[16] Hayles, *Chaos Bound*, p. 55.

existence of a power that destabilizes the capacity for explanation."[17] He does not give this 'power' or force a name, but we may identify deterministic chaos as one example of it. Lyotard argues that this destabilising power "generates blind spots" in our analyses of events. Lyotard argues that his power also makes the future "unpredictable" in the same way that the future behaviour of a nonlinear dynamical system is unpredictable.[18] Lyotard then combines the scientific concept of indeterminism with his own concept of local knowledge, and compares how local knowledge is able to counteract the effects of global knowledge and grand narratives with the way that deterministic chaos undermines forms of linear order. He argues from this analogy that determinism is limited to localities: the world is globally disordered, and ordered only in certain localities.[19] Instead of attempting to understand the 'nature of reality' on a global scale, nonlinear science indicates that we can only strive to understand the nature of local events. For Lyotard, the postmodern science of paralogy is unable to transform the unknown into the known: instead, science defines a language-game that produces "the unknown."[20]

Accepting the cogency of Lyotard's argument, the destabilising power he discusses has profound epistemological implications, including the power to undermine the western worldview. He identifies and elucidates some of the central ideas of nonlinear science as he saw it while it was developing into the discipline of chaos theory, and this has proven to be extremely influential. Much of the later critical interpretation of chaos theory has come to rely on Lyotard's interpretative strategies, his choice of scientific metaphors, and his methodology of combining scientific and cultural ideas to

[17] *Ibid*., p. 61.
[18] *Ibid*., p. 61.
[19] This is fundamentally the same argument as that offered by Michel Serres, who suggests that order can only exist in isolated pockets of organisation, or as he explains it, "negentropic islands on or in the entropic sea." See Michel Serres, *Hermes: Literature, Science, Philosophy*, edited by Josué V. Harari and David F. Bell. Baltimore: John Hopkins University Press, 1982, p. 75. Harari and Bell summarise Serres as suggesting that truth "functions only in the context of local pockets, a truth that is always local, distributed haphazardly in a plurality of spaces." See Harari and Bell, "Introduction: Journal a Plusieurs Voies," in *Hermes*, p. xiii. Alexander J. Argyros argues that Lyotard follows Thom in suggesting that "determinism will be a limited, local phenomenon, and that the norm will be discontinuity, unpredictability, and contradiction." See Argyros, *A Blessed Rage for Order*, p. 234. Argyros also quotes Lyotard from *The Postmodern Condition* as stating that "[a]ll that exists are 'islands of determinism.'" See Argyros, *A Blessed Rage for Order*, p. 234, and Lyotard, *The Postmodern Condition*, p. 59. We can thus follow the development of this metaphor from Thom and Serres to Lyotard.
[20] Lyotard, *The Postmodern Condition*, p. 60.

enable the rapid transfer of scientific principles into critical thought. Lyotard's discussion of the paradoxical nature of nonlinear science is extremely important to later interpretations of chaos theory, for it has established the critique of chaos theory as a discourse that has grown alongside that of chaos theory.[21] Lyotard's interpretation of nonlinear science demonstrates that cultural interpretations of scientific ideas can produce valuable results. Despite the problems that later become associated with the cultural interpretation of chaos theory, Lyotard exemplifies the speculative, intuitive, and optimistic interpretation of chaos theory that Prigogine and Stengers were soon to speak of in *La Nouvelle Alliance*, but which did not yet exist in any other context. Lyotard's interpretation of nonlinear science as paralogy in *The Postmodern Condition* has had a substantial effect on Hayles and Baudrillard. While neither entirely agrees with the tenets of Lyotard's text, both demonstrate that Lyotard's interpretation of chaos theory has provided an essential point of departure for their own.

N. KATHERINE HAYLES

A quite different perception of chaos theory is formulated by N. Katherine Hayles. This section will examine Hayles' interpretation of chaos theory in "Chaos as Orderly Disorder: Shifting Ground in Contemporary Literature and Science" (1988), *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (1990), and in the Introduction to the collection of essays edited by Hayles: *Chaos and Order: Complex Dynamics in Literature and Science* (1991). *Chaos Bound* is the more significant of the two texts, but *Chaos and Order* is important in that it signifies the complexification of the literary interest of chaos theory and because it hints at the diverse possibilities of chaos theory for literature.[22]

[21] The significance of *The Postmodern Condition* is especially evident when compared to *The Inhuman: Reflections on Time*: many of the ideas presented in this text are implicitly based on chaos theory principles, on Thom's catastrophe theory, and on Shannon's information theory. See Lyotard, *The Inhuman: Reflections on Time*, translated by Geoffrey Bennington and Rachel Bowlby, Cambridge: Polity Press, 1991 (*L'Inhumain: Causeries sur le temps*. Paris: Éditions Galilée, 1988), especially pp. 15, 22, 70, 153, 166.

[22] In *Chaos and Order* David S. Porush, Sheila Emerson, and Thomas P. Weissert apply chaos theory to a variety of texts. In "Fictions as Dissipative Structures: Prigogine's Theory and Postmodernism's

Firstly, some consideration will be given to "Chaos as Orderly Disorder" which, although it is essentially an early version of the Introduction to *Chaos Bound*, nonetheless contains some distinct comments which serve to illustrate the development of Hayles' interest in chaos theory. A comparison of "Chaos as Orderly Disorder" and *Chaos Bound* demonstrates that Hayles' reading of chaos theory evolved from her interest in Shannon's information theory which is explored in "Information or Noise? Economy of Explanation in Barthes' *S/Z* and Shannon's Information Theory" (1987). "Chaos as Orderly Disorder" marks a transition from information theory to chaos theory as Hayles' primary concern.[23] Hayles argues in "Chaos as Orderly Disorder" that "Shannon's theory was appropriated by chaos theorists to redefine chaos as maximum information."[24] This statement provides the transitive focus in Hayles' study from information theory to chaos theory: the territory Hayles will explore in her subsequent texts. Hayles focuses on chaos theory in relation to literature and culture in "Chaos as Orderly Disorder," arguing that chaos theory and postmodernism both arose out of the same culture, a culture which establishes chaos and disorder as fundamental first principles.[25] The convergence of nonlinear science and chaos theory has resulted in what Hayles describes as the "transvaluation" of chaos.[26] This transvaluation is only briefly considered in "Chaos as Orderly Disorder" but it forms much of *Chaos Bound*, which provides a thorough and informative introduction to the literary perception of chaos theory and represents an excellent starting point for delving further into the chaotic dynamics of fictional systems.

Roadshow," Porush discusses the chaotic dynamics of traffic jams in Jean Luc Godard's film *Weekend*, Don DeLillo's *White Noise*, and William Marshall's *Roadshow*. See Porush, "Fictions as Dissipative Structures," in *Chaos and Order: Complex Dynamics in Literature and Science*, edited by N. Katherine Hayles, pp. 54-5; and William Marshall, *Roadshow*, New York: Henry Colt & Co., 1985. The chaotic nature of traffic is considered a serious subject of inquiry in chaos theory, and is discussed by Ilya Prigogine and Robert Herman in *Kinetic Theory of Vehicular Traffic*, New York: Elsevier, 1971, and "A Two-Fluid Approach to Town Traffic," in *Science*, Volume 204, 1979, pp. 148-51. See also Sheila Emerson, "The Authorization of Form: Ruskin and the Science of Chaos," pp. 149-66; and Thomas P. Weissert, "Representation and Bifurcation: Borges's Garden of Chaos Dynamics," pp. 223-43.

[23] Hayles, "Chaos as Orderly Disorder: Shifting Ground in Contemporary Literature and Science," in *New Literary History: A Journal of Theory and Interpretation*, Volume 20, No. 2, 1988, pp. 305-22, p. 305.

[24] *Ibid*., p. 306.

[25] *Ibid*., p. 321.

[26] *Ibid*., p. 320.

Hayles' interpretation of chaos theory in *Chaos Bound* focuses on the ways in which the discourse of chaos theory is perceived by science and the humanities. *Chaos Bound* has two main functions. Firstly, it examines how the application of information theory and chaos theory to literary criticism has been made possible by critical changes, whereby texts have been defined as disordered systems from which complex order can be obtained through interpretation.[27] Secondly, it also examines a variety of fictional texts.[28] Hayles acknowledges that science and literature share an over-riding interest in chaos theory, its principles, and its vocabulary, but she argues that the two cultures express this interest in quite different ways. These differences are made explicit through the manipulation of language within literature, its representational practices, and its exploitation of slippages in signification to transform chaos theory into literary metaphors. It is through these processes that the transvaluation of chaos theory occurs.

Although aided by science itself in the creation of these metaphors, it is their application to fictional systems and to literary criticism and theory that defines the literary use of chaos theory, and thus what is of primary concern to Hayles. She argues that what is important about chaos theory for literature and culture is not its construction of "new theories and techniques" but its "re-visioning" of the world: in other words, its definition of a new worldview.[29] This worldview has the potential to unite science and the humanities. Hayles' method in *Chaos Bound* is to examine both the similarities and the differences between chaos theory and postmodernism to ascertain what impact the former has had on the latter. The similarities Hayles perceives between the two paradigms will be outlined first, and a discussion of the differences which reveal problematical aspects of the literary use of chaos theory will follow.

The convergence of chaos theory and deconstruction is central to *Chaos Bound*. Hayles argues that deconstruction "shares with chaos theory the desire to breach the boundaries of classical systems by opening them to a new kind of analysis in which

[27] Hayles, "Chaos as Orderly Disorder," p. 320.
[28] These texts include Henry Adams' *The Education of Henry Adams*, edited by Ernest Samuel, Boston: Houghton Mifflin, 1973; Doris Lessing's *The Golden Notebook*, New York: Bantam, 1962; and Stanislaw Lem's *His Master's Voice*, translated by Michael Kandel, New York: Harcourt Brace Jovanovich, 1983.
[29] Hayles, *Chaos Bound*, p. 143.

information is created rather than conserved."[30] Hayles examines this subject through a comparison of Derrida's deconstructive method and use of iteration and the use of iteration in chaos theory, particularly by the chaologist Mitchell Feigenbaum. She argues that "Derrida's deconstructive methodology is strikingly similar to the mathematical techniques of chaos theory."[31] The principle of indeterminacy is fundamental to Hayles' comparison of chaos theory and deconstruction: just as Derrida believes that the origins of signification cannot be specified, so chaologists believe that they cannot specify the initial conditions that determine the behaviour of complex systems:

> Derridean deconstruction and nonlinear dynamics are strikingly parallel in a number of ways. They agree that bounded, deterministic systems can nevertheless be chaotic; they both employ iteration and emphasize folds; and they concur that originary or initial conditions cannot be specified exactly.[32]

To Hayles, deconstruction "exposes the interrelation between traditional ideas of order and oppressive ideologies" in the same way that chaos theory questions the domination of the discourse of order.[33]

The significance of indeterminism for Hayles is that it imposes limits on the epistemological power of both chaos theory and deconstruction. Indeterminism thus has analogous implications for both science and literature: she comments that "chaos theory is marked by the ambivalence characteristic" of all postmodern ideas.[34] Hayles' interpretation of the impact of chaos theory on culture thus differs from that of Lyotard: whereas he views nonlinear science as a source of ideas that indicates that the grand narratives of modern society may be overthrown, Hayles considers that this is unlikely to occur. Chaos theory is already invested with ambiguity within the scientific realm, and she argues that this ambiguity is magnified when its transvaluation into literary and cultural discourses occurs.

Hayles is as concerned with identifying where and how chaos theory and postmodernism are dissimilar as she is with examining their points of convergence. Despite identifying what she considers to be significant similarities between chaos theory

[30] *Ibid*., p. 176.
[31] *Ibid*., p. 183.
[32] *Ibid*., p. 184.
[33] *Ibid*., pp. 16-17.
[34] *Ibid*., p. 293.

and postmodernity, Hayles also draws attention to some of the problematical aspects of the literary use of chaos theory and makes it clear from the start of *Chaos Bound* that she is concerned with "rifts as well as convergences."[35] The major problem Hayles identifies with the literary interpretation of chaos theory is that it does not thoroughly differentiate between various definitions and connotations of chaos, and that it conflates the concept of chaos as anti-order with the scientific concept of chaos as deterministic chaos. Fundamentally, Hayles believes that the transvaluation of chaos theory into literature and culture occurs at the expense of focus with which chaos operates in science. The concept of chaos has been popularised in contemporary culture because it has maintained its connotation as anti-order in conjunction with the scientific concept of deterministic chaos, thus rendering imprecise cultural references to deterministic chaos.

The ambiguity with which the concept of chaos operates in contemporary culture is not purely the product of its transvaluation or interpretation. Hayles suggests that chaos theory and postmodernism privilege the concept of disorder over the concept of order: both paradigms "invert traditional priorities: chaos is deemed to be more fecund than order, uncertainty is privileged above predictability, and fragmentation is seen as the reality that arbitrary definitions of closure would deny."[36] In her Introduction to *Chaos and Order* Hayles argues that chaos has been routinely perceived as "anti-order" in western culture rather than as "not-order."[37] Order has been consistently valued in western culture as a signifier of good, whereas chaos and disorder has been viewed negatively as the Other: as alien to traditional knowledge. These traditional distinctions are challenged by the convergence of chaos theory and postmodernism, which conversely privileges chaos over order.

The privileging of chaos is evident a number of texts including Alvin Seltzer's *Chaos in the Novel: The Novel in Chaos* (1974).[38] Seltzer sets up a simple binary opposition between order and chaos or disorder: he does not refer to the concept of deterministic chaos, but to connotations of chaos as disorder or anti-order. *Chaos in the Novel* was written before the emergence of chaos theory, and contains no references to

[35] *Ibid*., p. 177.
[36] *Ibid*., p. 176.
[37] Hayles, *Chaos and Order*, p. 3.

deterministic chaos, although traces of the cultural interest in chaos are obvious. Because it now coexists with texts that explicitly refer to chaos as deterministic chaos, *Chaos in the Novel* and similar texts contribute to the ambiguity with which chaos is viewed in literature. The representation of chaos as anti-order constitutes a dilemma for Hayles, for in promoting disorder over order postmodern literature perpetuates and reinforces the binary oppositions it wishes to refute and furthers the obfuscation of chaos referents.

According to Hayles, the ambiguity of chaos stems from the fact that scientists and critics use chaos for different reasons: "where scientists see chaos as the source of order, poststructuralists appropriate it to subvert order."[39] Hayles argues that "[l]iterary theorists value chaos primarily because they are preoccupied with exposing the ideological underpinnings of traditional ideas of order. They like chaos because they see it as opposed to order."[40] She suggests that poststructuralist theorists employ the concept of chaos to signify their difference from the modern concept of linear order: "disorder has become a focal point for contemporary theories because it offers the possibility of escaping from what are increasingly perceived as coercive structures of order."[41] The poststructuralist perception of chaos as a principle that can enervate grand narratives differs from and potentially subverts the notion of deterministic chaos. The literary interpretation of chaos theory defines itself as distinct from that of science through this equivocation.

The different applications of the term chaos are representative of the applications that scientists and poststructuralist perceive for chaos theory itself: Hayles states that "[f]or deconstructionists, chaos repudiates order; for scientists, chaos makes order possible."[42] Scientists use chaos theory to perceive further forms of order in the world whereas poststructuralists use chaos theory to deny that order exists. By replacing the grand narrative of linear order with a narrative of anti-order, poststructuralism facilitates the substitution of one grand narrative for another. The poststructuralist conception of chaos theory as a politically subversive discourse, which is supported by Lyotard in *The*

[38] Alvin Seltzer, *Chaos in the Novel: The Novel in Chaos*, New York: Schocken, 1974.
[39] Hayles, *Chaos Bound*, p. 176.
[40] *Ibid*., pp. 22-23.
[41] *Ibid*., p. 265.
[42] *Ibid*., p. 184.

Postmodern Condition, makes the cultural reception of deterministic chaos problematic, and undermines its definition as a third or differing force that fragments the order-disorder binary opposition.

Hayles argues in *Chaos Bound* that the poststructuralist approach to chaos has been "conservative" because it has perpetuated rather than challenged the practices of the discipline.[43] She expresses ambivalence about the convergence of chaos theory and postmodernism, especially her comparison of chaos theory and deconstruction, in response to the extent of this equivocation. She also admits to being "wary of the claim that chaos theory provides confirmation from within the physical sciences that totalizing perspectives are no longer valid."[44] Hayles' ambivalence about the ambiguity created by multiplicitous connotations of chaos, and her unwillingness to endorse the political application of chaos theory, characterise her consideration of the literary use of chaos theory. Hayles debates whether chaos theory supports or subverts the grand narrative of modern science, and whether postmodernism contributes to the establishment or subversion of chaos theory as a grand narrative. She argues that chaos theory and postmodernism both question the extent to which they represent grand narratives, but in contrast to Lyotard she remains unconvinced that chaos theory has liberatory implications.

In *Chaos Bound* Hayles argues that "[c]haos theory has a double edge that makes appropriations of it problematic for humanistic arguments that want to oppose it to totalizing views."[45] She is less concerned with furthering the application of chaos theory to literary criticism than she is with unravelling the theoretical guise of the literary interpretation of chaos theory. This approach necessitates the critical tone that Hayles adopts in relation to the poststructuralist application of chaos theory to refute grand narratives. Hayles suggests that chaos theory and postmodernism both contribute to and resist the globalising tendencies of modern science and modern culture:

> The science of chaos shares with other postmodernisms a deeply ingrained ambivalence toward totalizing structures. On the one hand, it celebrates the disorder that earlier scientists ignored or disdained, seeing turbulent flow not as an obstacle to scientific progress but as a great swirling river of information that rescues the world from sterile

[43] *Ibid*., p. 176.
[44] *Ibid*., p. 15.
[45] *Ibid*., p. 15.

> repetition. On the other hand, it also shows that when one focuses on the underlying recursive symmetries, the deep structures underlying chaos can be revealed and analytical solutions can sometimes be achieved. It is thus like other postmodernisms in that it both resists and contributes to globalizing structures.[46]

Neither chaos theory nor postmodernism completely subvert globalising, ordering tendencies nor transcend the paradigms that precede them.

In this instance Hayles defers to the scientific conceptualisation of chaos theory rather than its cultural perception, remarking that chaos theory challenges "the primacy traditionally accorded to ordered systems" but it still relies on the concept of order to distinguish deterministic chaos from order and disorder.[47] This statement reflects the view of chaos held by many scientists, such as the physicist David Bohm, who points out in "Postmodern Science and a Postmodern World" (1988) that while the concept of chaos has been privileged over order by some theorists, the continued interest expressed in chaos in both scientific and cultural spheres indicates that the concept of order still has a significant role to play in critical examinations of complex systems because the concepts of chaos and order are inextricably interwoven.[48]

Hayles does not simply adopt chaos theory: her methodology is to examine the fundamental principles of chaos theory and to consider their theoretical implications for literature. Thus, her approach to chaos theory, and to science in general, is to consider its ideas without adopting them in an uncritical manner. Her ambivalence about chaos theory is provoked by the style of its literary appropriation but also by chaologists who consider chaos theory as a form of knowledge that will allow them to eliminate or compensate for chaos by altering the nonlinear dynamics of complex systems. Some chaologist use the principles of deterministic chaos to negate its effects, such as by converting nonlinear behaviour to linear behaviour.[49] While there is no way of determining how effective this application of chaos theory will be, the practice of eliminating chaos fundamentally undermines its philosophy: to understand, rather than to

[46] *Ibid*., p. 291.
[47] *Ibid*., pp. 16-17.
[48] Bohm, "Postmodern Science and a Postmodern World," in *The Reenchantment of Science: Postmodern Proposals*, pp. 57-68, p. 65.
[49] See for example: Ralph Stacy, *The Chaos Frontier: Creative Strategic Control for Business*, Oxford: Butterworth-Heinemann, 1991; Gregg Johnson, "Keeping Chaos at Bay," in *IEEE Spectrum*, Volume 30, 1993, pp. 32-6; and William L. Ditto and Louis M. Pecora, "Mastering Chaos," in *Scientific*

control, deterministic chaos. Hayles' ambivalence is upheld by Kellert, who argues in *Wake of Chaos* that the aim of chaos theory is the same as that of any other scientific paradigm: to dominate and control nature: to "see chaos theory as a revolutionary new science that is radically discontinuous with the Western tradition of objectifying and controlling nature falsifies both the character of chaos theory and the history of science."[50]

Hayles' interpretation of chaos theory is tempered by caution, and diverges sharply from the more ambitious interpretations of other critics. One indicator of this difference is found in Hayles' reading of the local/global nexus and her commentary on Lyotard's conceptualisation of the relationship between chaos theory and postmodernism. This is considered in both "Chaos as Orderly Disorder" and *Chaos Bound*, but each text provides a unique perspective on the issue. In "Chaos as Orderly Disorder" Hayles suggests that Lyotard's claim that paralogy subverts global discourses "confuses scientific theories with social programs."[51] She equates the unsubstantiated cultural application of scientific ideas with "social Darwinism," thus indicating that Lyotard's use of nonlinear science is undisciplined and that its cogency suffers accordingly.[52] This is an extremely pertinent criticism, for it identifies similarities between Lyotard's idealistic adoption of chaos theory and the idealistic, and inherently undisciplined, social and moral adoption of Darwinian evolutionary theory, which has gained negative associations in the twentieth century in the context of totalitarian ideologies of racial purity.

In *Chaos Bound* Hayles' tone is more measured, and her analysis of Lyotard's interpretation of nonlinear science is tempered by respect for his achievements. In particular, Hayles considers Lyotard's interest in paradoxes, arguing that he prioritises their study in *The Postmodern Condition* because he believes that they "invalidate global concepts and valorize local knowledge."[53] However, she questions Lyotard's suggestion that paralogy may be associated with liberatory political implications:

American, Volume 269, 1993, pp. 78-84.
[50] Kellert, *Wake of Chaos*, pp. 115-16.
[51] Hayles, "Chaos as Orderly Disorder," p. 311.
[52] *Ibid*., p. 311.
[53] Hayles, *Chaos Bound*, p. 288.

> Lyotard sees in some aspects of chaos models, particularly fractal geometry, as promising a release from totalizing narratives. Yet other aspects of chaos theory bring this vision into question, for they embody a shift in perspective away from the individual and toward systematic organization.[54]

Hayles' reading of Lyotard's paralogy is important because it hints at the wider issue that confronts the literary use of chaos theory: the contested legitimacy of literary perceptions of science.

Hayles is acutely aware of potential problems associated with nonlinear and postmodern science. She states in *Chaos Bound* that "[t]o speak of the sciences of chaos theory as postmodern science is not in my view to speak incorrectly," although she then clarifies this statement by arguing that to define chaos theory as postmodern science is to speak "carelessly" unless the specifically postmodern characteristics of chaos theory are explicitly defined.[55] This is something that Lyotard fails to do: he promotes nonlinear science as inherently postmodern without considering that some aspects of it are not so much a radical departure from modern science as a progressive refinement of it. Hayles is balanced in her assessment of Lyotard's interpretation of nonlinear science in *Chaos Bound*, defining his elevation of the paradox as "misguided" but praising his consideration of nonlinear science and postmodernism in general.[56]

Hayles defines attempts to describe chaos theory as a radical departure from normal science as naive, for "chaos theory is not opposed to normal science; it *is* normal science."[57] She argues that postmodern interpretations of chaos theory must be grounded by the recognition that it is not a radical discipline opposed to the epistemological and methodological history of the rest of science. To this end Hayles is also critical of Michel Serres' use of chaos theory, although she is evidently also appreciative of the insight that both Lyotard and Serres bring to its interpretation:

> In one sense Serres is a man ahead of his time, for he understands that the reevaluation of chaos within contemporary paradigms is a cultural shift of the first importance. It signals not just a new scientific or literary theory but a shift in the ground of representation itself.

[54] *Ibid*., p. 27.
[55] *Ibid*., p. 292.
[56] *Ibid*., p. 288.
[57] *Ibid*., p. 15.

> However, the passage between wacky theorizing and brilliant insight is so narrow that it is sometimes hard to say on which side it falls.[58]

Hayles attempts to expose this "wacky theorizing" while developing and extending the idea that chaos theory and postmodernism are convergent in a number of contexts.

In her Introduction to *Chaos and Order* Hayles again considers the question of the legitimacy of the cultural appropriation of scientific ideas, arguing that claims that "scientific theories... validate cultural theses" must be considered "skeptically."[59] Hayles concludes that literary and cultural critics should not take the discourse of chaos theory for granted, for its potential to become a grand narrative is never far from being actualised. Reductive scientific applications of chaos indicate to Hayles that chaos theory represents far more than a set of radical, non-reductive, values. Her caution stems from her hypothesis that distinctions between "legitimate and illegitimate" cultural uses of scientific language are "not so easily drawn."[60] Despite acknowledging the ambiguous legitimacy of literary interpretations of chaos theory, Hayles does affirm that it possesses value for literature. While some critics would argue that it is necessarily a grand narrative, Hayles responds that it is not chaos theory itself that is problematic but the specifics of its interpretation and application. As she indicates in *Chaos Bound*, chaos theory is used in different ways by different people, and while it has the potential to become a grand narrative, it also has the potential to avoid becoming one. Chaos theory has two facets: it tries to resist its globalising, totalising tendencies by accepting the irrational and the unknown, while simultaneously trying to overcome indeterminism by identifying order within disorder.[61] The literary appropriation of chaos theory exposes the contradictory elements of chaos theory by replicating them: like chaos theory itself, the literary applications of it resist grand narratives whilst attempting to determine the undetermined.

[58] *Ibid*., p. 207.
[59] Hayles, *Chaos and Order*, p. 15.
[60] *Ibid*., p. 18.
[61] Hayles, *Chaos Bound*, p. 140.

JEAN BAUDRILLARD

This section will examine Jean Baudrillard's science-related writings, and will focus predominantly on three of his texts that specifically refer to chaos theory: "Fatality or Reversible Imminence: Beyond the Uncertainty Principle" (1981), *The Transparency of Evil: Essays on Extreme Phenomena* (1993), and *The Illusion of the End* (1994). A number of Baudrillard's other texts, including *America* (1988), *The Ecstasy of Communication* (1988), and *Cool Memories II* (1996) will also be referred to here. The structure of Baudrillard's use of chaos theory determines the structure of its interpretation: hence this section will consider these texts concomitantly rather than sequentially. Baudrillard's epistemology of indeterminism, his application of chaos theory to social and historical systems, and the effect of his interpretation of chaos theory on his readers, are issues that will be considered here.

The issue of Baudrillard's epistemology will be considered first. His formulation of an epistemology of indeterminism based on chaos theory demonstrates both facets of the appropriation of chaos theory - its interpretation and application to social systems - and represents one of the most sophisticated syntheses of chaos theory and contemporary critical thought. His strategy for developing an epistemology of indeterminism is to transpose the values of chaos theory onto his theory of simulation. The innovative strategy of linking chaos to simulation combines a new aspect of Baudrillard's critical thought with an existing one, which gives him a firm theoretical basis upon which to establish his interpretation of chaos theory, as well as providing his readers with an established framework from which to consider his application of it. This involves a degree of slippage between scientific and cultural connotations of chaos. For Baudrillard, chaos represents "exponential instability and its uncontrollable effects."[62]

By combining chaos and simulation, Baudrillard is able to argue that there is a "fractal" stage of value, and that chaotic values have contributed to the development of his theory of simulacra. Like Lyotard in *The Postmodern Condition*, Baudrillard is drawn to Mandelbrot's fractal theory and employs similar metaphors in appropriating fractal

[62] Baudrillard, *The Illusion of the End*, translated by Chris Turner, Cambridge: Polity Press, 1994, p. 111.

theory. Baudrillard suggests in *The Transparency of Evil* that chaotic and fractal values do not replace existing values but supplement them:

> A new particle does not replace those discovered earlier: it simply joins their ranks, takes its place in a hypothetical series. So let me introduce a new particle into the microphysics of simulacra. For after the natural, commodity, and structural stages of value comes the fractal stage. The first of these stages had a natural referent, and value developed on the basis of a natural use of the world. The second was founded on a general equivalence, and value developed by reference to a logic of the commodity. The third is governed by a code, and value develops here by reference to a set of models.[63]

In this passage Baudrillard provides a foundation for his application of chaos theory to his theory of simulation.

Baudrillard then defines the fractal stage of value, building on what he has outlined in the previous passage:

> At the fourth, the fractal (or viral, or radiant) stage of value, there is no point of reference at all, and value radiates in all directions, occupying all interstices, without reference to anything whatsoever, by virtue of pure contiguity. At the fractal stage there is no longer any equivalence, whether natural or general. Properly speaking there is now no law of value, merely a sort of *epidemic of value*, a sort of general metastasis of value, a haphazard proliferation and dispersal of value. Indeed, we should really no longer speak of 'value' at all, for this kind of propagation or chain reaction makes all valuation impossible.[64]

He relates the properties of fractal images to the system of simulacra to suggest that signification follows inherently nonlinear paths:

> Just as each particle follows its own trajectory, each value or fragment of value shines for a moment in the heavens of simulation, then disappears into the void along a crooked path that only rarely happens to intersect with other such paths. This is the pattern of the fractal - and hence the current pattern of our culture.[65]

He compares the fractal or nonlinear nature of chaotic systems to that of "our culture" - contemporary western culture. His description of the "crooked" values of fractals suggests that the path of contemporary culture is similarly crooked.[66]

Baudrillard's use of chaos theory's concept of unpredictable yet deterministic change fundamentally informs his view of human behaviour and the nature of society. He

[63] Baudrillard, *The Transparency of Evil: Essays On Extreme Phenomena*, translated by James Benedict, London: Verso, 1993, p. 5 (*La Transparence du Mal: Essai sur les Phenomenes Extremes*, Paris: Éditions Galilée, 1990).
[64] *Ibid*., p. 5.
[65] *Ibid*., p. 6.
[66] I do not believe that Baudrillard implies that contemporary culture is dishonest in his use of

declares in *The Transparency of Evil* that the "revolution of our time is the uncertainty revolution" and argues that contemporary culture is undergoing a dramatic change or paradigm shift from lesser to greater disorder.[67] Baudrillard frames this change towards uncertainty in the context of a change that is already widely discussed in contemporary critical discourse - the loss of the subject/object dichotomy - and argues that it has immensely effected both culture and science:

> What is constant is an immense uncertainty, an uncertainty which lies at the core of the present operational euphoria. The natural sciences were the first to describe a panic situation of this kind: it is the disappearance of the respective positions of subject and object at the experimental interface that has given rise to a definitive state of uncertainty about the reality of the object and the (objective) reality of knowledge. Science itself seems to have fallen under the sway of its strange attractors.[68]

It is in this passage that Baudrillard acknowledges the extent of the influence of chaos theory on culture, for he recognises that the sciences first defined the current preoccupation with uncertainty.

Chaos theory is significant for Baudrillard because he believes that it has implications for disciplines far beyond science: it encompasses a revolution of uncertainty that is being experienced by many disciplines. Baudrillard suggests that the principles of chaos theory may be more than metaphors: they are directly applicable to social systems, and effectively function not only as descriptive metaphors but as prescriptive indicators of social trends and conditions. He proposes in *The Transparency of Evil* that:

> we are apparently dealing with a sort of massive phase transition in a human system in disequilibrium. As with physical systems proper, this phase transition remains largely mysterious for us, but the catastrophic development in question is in itself neither beneficial nor malignant: it is simply catastrophic.[69]

This "phase transition" from order to disorder is central to Baudrillard's epistemology. Mike Gane makes a significant contribution to Baudrillard scholarship by commenting on the history of the development of Baudrillard's epistemology in *Baudrillard: Critical and Fatal Theory* (1991). He argues that Baudrillard "has attempted to develop a

'crooked,' but that it is irregular and haphazard.

[67] Baudrillard, *The Transparency of Evil*, p. 43.

[68] *Ibid*., p. 42.

[69] *Ibid*., p. 100.

remarkable epistemological reflection" based on "indeterminism and probability."[70] Through this epistemology, Baudrillard is able to consider "the nature of chance, chaos and probability" and to examine the social implications of these concepts.[71]

The extended period of time during which Baudrillard has developed this epistemology becomes clear when "Fatality or Reversible Imminence" is compared to *The Transparency of Evil*. In the former text Baudrillard argues that "we have substituted, for the reign of intelligible causes, not true chance but a more mysterious mechanism of interconnections."[72] He suggests that this mechanism produces a "radically different... nonrandom order."[73] Baudrillard distinguishes deterministic chaos from simple disorder and argues that deterministic chaos produces a radically different ordering of causal systems from that of modern science. In *The Transparency of Evil* he gives a similar explanation of the chaotic dynamics of social systems, describing in Gane's words the existence of a world "which secretly ordains, through esoteric affinities, an order which is determinate, determined, but quite different from that of the physical or social universe defined by the sciences."[74] This different order is ruled by "esoteric affinities" or strange attractors which initiate changes in the behaviour of complex nonlinear systems.

Baudrillard's use of chaos theory to construct this epistemology is also discussed by Stephen Watt in "Baudrillard's America (and Ours?): Image, Virus, Catastrophe" (1991). Like Gane, Watt demonstrates that Baudrillard's application of nonlinear science principles to social systems is not a recently adopted strategy, but one that he has developed over a considerable period of time. It is useful to compare Watt's reading of Baudrillard's use of chaos theory to Gane's in relation to this assertion, for whereas Gane discusses "Fatality or Reversible Imminence" Watt focuses on *America* and *The*

[70] Mike Gane, *Baudrillard: Critical and Fatal Theory*, London: Routledge, 1991, p. 167. Gane points out that "Fatality or Reversible Imminence: Beyond the Uncertainty Principle" is a partial translation of Baudrillard's *Les Strategies Fatales*, Paris: Grasset, 1983, which was eventually fully translated as *Fatal Strategies* by Philip Beitchman and W. G. J. Niesluchowski, edited by Jim Fleming, London: Pluto, 1990. See Baudrillard, "Fatality or Reversible Imminence: Beyond the Uncertainty Principle," translated by Pamela Park, *Social Research*, Volume 49, No. 2, 1981, pp. 272-93 (Note: this is a part translation of *Les Strategies Fatales*. Paris: Grasset, 1983).

[71] Gane, *Baudrillard: Critical and Fatal Theory*, p. 169.

[72] Baudrillard, "Fatality or Reversible Imminence," p. 273.

[73] *Ibid*., p. 273.

Ecstasy of Communication.[75] Comparing the texts of Gane and Watt reveals a consistent perception of Baudrillard's application of chaos theory to social systems. For instance, Gane's argument that Baudrillard's epistemology of indeterminism has developed over an extended period of time is supported by Watt.

Watt asserts in "Baudrillard's America" that Baudrillard makes two radical epistemological shifts that have been prompted by his reading of nonlinear science texts. He argues that the first epistemological shift is to incorporate the implications of chance and randomness represented in Jacques Monod's genetic theory, particularly as this is defined in *Le Hasard et la Necessité: Essai sur la Philosophie Naturelle de la Biologie* (1970).[76] From Monod, Baudrillard gains a set of concepts that includes chance, randomness, and the accident, all of which figure as focal themes in the discourse of chaos theory.[77] Watt then argues that the second epistemological shift Baudrillard makes is to accept "the potential for sudden change, a stemming of the seemingly ineluctable operation of a dynamic system described by catastrophe theorists."[78]

The second shift made by Baudrillard is prompted by his reading of Thom's *Stabilitè Structurelle et Morphogenèse*. Baudrillard ascertains from Thom that nonlinear science has significant implications for cultural systems. Thom transforms Monod's concepts into new entities: chance becomes catastrophe, and the accident is no longer a purely random event, but one that is triggered by complex, ambiguous causes. In other words, chance or random events have been redefined as catastrophes and disastrous accidents triggered by specific, though indeterminate, causes. Watt argues that Baudrillard, armed with these new definitions of catastrophe and the accident, rejects

[74] Gane, *Baudrillard: Critical and Fatal Theory*, p. 208.

[75] Stephen Watt, "Baudrillard's America (and Ours?): Image, Virus, Catastrophe," in *Modernity and Mass Culture*, edited by James Naremore and Patrick Brantlinger, Bloomington: Indiana University Press, 1991, pp. 135-57, p. 146. See Baudrillard, *America*, translated by Chris Turner, London: Verso, 1988 (*Amerique*. Paris: Grasset, 1986), and *The Ecstasy of Communication*, translated by Bernard and Caroline Schutze, edited by Slyvere Lotringer, New York: Semiotext(e), 1988 (*L'Autre par lui-meme*. Paris: Éditions Galilée, 1987).

[76] *Ibid*., pp. 140-141. See Monod, *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*, translated by Austryn Wainhouse, New York: Knoph, 1971 (*Le Hasard et la Necessité: Essai sur la Philosophie Naturelle de la Biologie Moderne*, Paris: Editions du Seuil, 1970).

[77] Watt, "Baudrillard's America," pp. 140, 144.

[78] *Ibid*., p. 141.

Monod's definitions in favour of those forwarded by Thom.[79] The second of these epistemological shifts is obviously the more significant of the two, and the one that Baudrillard has pursued in his more recent texts, especially *The Transparency of Evil*.

Watt suggests that Thom's catastrophe theory represents for Baudrillard a theory of "systematized, albeit largely unpredictable, indeterminacy."[80] To Baudrillard, catastrophes are literally "collapsings of meaning" which destabilise prediction hence the possibility that meaning can be produced.[81] This "systematized indeterminacy" incorporates notions of both order and disorder consistent with the fundamental paradox of deterministic chaos. Baudrillard uses the term 'catastrophe' to describe "an order that counters rational or causal sequences."[82] This form of order is however distinguishable from random indeterminacy. Baudrillard does not use chaos to signify anti-order or randomness in his texts: he defines it as a principle of nonlinear causality. He explains his application of chaos theory to social systems further in *The Illusion of the End*, arguing that the "distortion of causes and effects" in contemporary society engenders "a disorder or chaotic order" that mirrors "Chaos Theory and the disproportion between the beating of a butterfly's wings and the hurricane this unleashes on the other side of the world."[83] His implicit reliance on chaos theory in *The Transparency of Evil* emerges in *The Illusion of the End* as an explicit appropriation of postmodern science and an application of its principles to social systems.

The next issue to be discussed is Baudrillard's application of nonlinear dynamics to historical systems. Baudrillard is especially concerned with exposing the paradoxical effect of deterrence, which he defines as the desire to deter events from occurring, in postmodern culture by associating the concept of deterrence with nonlinear causality and with the butterfly effect. He argues in *The Illusion of the End* that history can be defined as a system of "probable causes and effects."[84] This suggests that events in historical systems cannot be predetermined: history can no longer be represented as a "the kind of

[79] *Ibid*., p. 140.
[80] *Ibid*., p. 146.
[81] Baudrillard, "Fatality or Reversible Imminence," p. 282.
[82] Watt, "Baudrillard's America," pp. 146-7.
[83] Baudrillard, *The Illusion of the End*, p. 110.
[84] *Ibid*., p. 21.

coherent unfolding of causes and effects we call reality."[85] Baudrillard argues instead that historical events can only be described as more or less probable, posing the view that history is the product not of planned and deliberate actions, but events which occur in no particular order and for no easily determinable reasons.[86] He implies that the very nature of events in postmodern culture leads to the suppression of linear causal systems and therefore "all historical continuity."[87]

Continuity is thus replaced with discontinuity in Baudrillard's historiography. He argues in *The Illusion of the End* that "history itself has to be regarded as a chaotic formation, in which acceleration puts an end to linearity and the turbulence created by acceleration deflects history definitively from its end, just as turbulence distances effects from their causes."[88] Baudrillard defines history as inherently nonlinear because social turbulence separates causes and effects, making it impossible to retrospectively establish the cause or causes of a specific event. Although the modernist principle of reduction continues to be enacted in postmodern culture, Baudrillard argues in *The Transparency of Evil* that it has become an almost useless exercise:

> When a forecast is made, no matter what it may be, it is always tempting to prove it wrong. Events themselves often help us out in this regard. There are overpredicted events, for instance, that obligingly decline to occur; and then there are the exactly opposite kind - those which occur without forewarning.[89]

The nonlinear causality evident in social systems makes it practically impossible to accurately forecast future events.

In rejecting predictable linear causality, Baudrillard rejects the established cultural applications of this scientific model. By instead accepting the discontinuous causality of chaos theory, Baudrillard strives to replace traditional social models of causality such as fate and destiny. He argues in *The Illusion of the End* that "[c]haos is a parody of any

[85] *Ibid*., p. 1.
[86] Of the contemporary appropriators of chaos theory, Baudrillard is not alone in questioning the historical consequences of indeterminism. Milan Kundera ironically comments that "the history of humanity... is not man's to determine..." See Kundera, *Testaments Betrayed*, translated by Linda Asher, London: Faber and Faber, 1996, p. 16.
[87] Baudrillard, *The Illusion of the End*, p. 110.
[88] *Ibid*., p. 111.
[89] Baudrillard, *The Transparency of Evil*, p. 39.

metaphysics of destiny."[90] The application of the principle of deterministic chaos indicates that destiny is outmoded; as Baudrillard proposes, it is only when "destiny is absent" that chaos proliferates.[91] The signs of destiny have been replaced by the signs of catastrophe: "[w]e know only the signs of catastrophe now; we no longer know the signs of destiny."[92] There can be no form of destiny in Baudrillard's network of social systems, where events are chaotically structured.

Baudrillard emphasises the importance of the concept of the accident in his interpretation of chaos theory by framing his model of historical causality on the nonlinear dynamics of deterministic chaos. It is clear from his initial exploration of chaos theory in "Fatality or Reversible Imminence" that he considers that what "happens by accident takes on a meaning and intensity that we no longer grant to rational events."[93] Baudrillard argues in this text that we "find ourselves in a paradoxical world where what is accidental takes on more meaning, more charm, than intelligible sequences."[94] Gane suggests from this that:

> the events which happen by chance seem to be more interesting or more significant than those things which happen as a result of the action of well-tried causes. These chance events are the 'special effects' of the universe, and they have a charm unmatched by the operation of rational forces.[95]

Accidents are events that occur despite human attempts at ordering the world: they occur beyond causality and thus beyond human control and responsibility.

Baudrillard further explores the concept of the accident in *The Illusion of the End* and *Cool Memories II*. To give an example of his application of chaos theory to social systems, he suggests in *The Illusion of the End* that the Chernobyl nuclear accident had a far greater effect on the collapse of communism in Eastern Europe than the Cold War.[96] The irony of this situation may be seen in two ways. Firstly, the nuclear accident at Chernobyl and other Soviet nuclear power stations "awaiting fissure and meltdown" are an attack on the west in that the radiation and fallout they produce affects western

[90] Baudrillard, *The Illusion of the End*, p. 113.
[91] *Ibid*., p. 113.
[92] *Ibid*., p. 114.
[93] Baudrillard, "Fatality or Reversible Imminence," p. 277.
[94] *Ibid*., p. 277.
[95] Gane, *Baudrillard: Critical and Fatal Theory*, pp. 170-1.

European countries, yet because Chernobyl was an accident no forceful retaliation was possible. Secondly, the former enemy, the west, has been forced to provide substantial financial and technical aid to avert further nuclear accidents and catastrophes in the former Soviet Union.[97]

Baudrillard is also interesting in what he sees as the paradoxical social reliance on ineffective predictive causal models. He indicates that the concept of historical indeterminism conflicts with the modern preoccupation with human agency as an effective causal mechanism in an ordered, predictable world. Although prediction has proven an unreliable mechanism, Baudrillard argues that prediction and deterrence will continue to function within the western world, for its basis within the worldview of modern science remains influential. Baudrillard examines deterrence in *Simulations* (1983) and also in *The Illusion of the End*, in which he argues that the strategy of deterrence is fundamentally ineffective in postmodern culture. In linear causal systems, the principle of deterrence suggests that events can be deterred as easily as they can be predicted.

Baudrillard's interest in the paradox of deterministic chaos is reflected in his definition of deterrence. He argues in *The Transparency of Evil* that deterrence represents a paradox of causality for contemporary culture:

> Paradoxically, however, we attempt to escape from uncertainty by relying even more on information and communication systems, so merely aggravating the uncertainty itself. This is a forward flight: the pursuit race of technology and its perverse effects, of man and his clones, around a track in the form of a Moebius strip, has only just begun.[98]

This paradoxical inversion of deterrence is also described in *The Illusion of the End*, in which Baudrillard argues that we create artificial catastrophes in our efforts to avoid natural disasters: "it is our pursuit of the means for averting natural catastrophe" that leads us to "manufactured" or "pre-programmed" catastrophes.[99] He describes deterrence as a destabilising force that can "remove all certainty about facts and evidence."[100] Deterrence can "destabilize memory just as it destabilizes prediction," and

[96] Baudrillard, *The Illusion of the End*, p. 39.
[97] *Ibid*., p. 49.
[98] Baudrillard, *The Transparency of Evil*, p. 43.
[99] Baudrillard, *The Illusion of the End*, p. 71.
[100] *Ibid*., p. 17.

deprives events of "meaning or linear end."[101] In *Cool Memories II* he again describes the paradoxical consequences of deterrence "[a]s you move away from one catastrophe, your get closer to the next."[102] The paradox of deterministic chaos suggests to Baudrillard that the more deterrence is attempted, the more likely it is that unwanted events will occur. He argues in *The Transparency of Evil* that "[n]atural disasters... suggest a kind of allergy - a rejection by nature of the operational dominance of human agency."[103] In the postmodern environment, the desire to deter events from happening has the paradoxical effect of increasing disorder.

One of the consequences of the collapse of order, prediction, and deterrence is that control and authority have also collapsed. In *Alterities: Criticism, History, Representation* (1996) Thomas Docherty argues that the notion of authority converges with Baudrillard's theory of deterrence: he argues that "Modernist authority is, to borrow Baudrillard's term, a 'scenario of deterrence.'"[104] Docherty argues from his analysis of the fragmentation of characterisation and its destabilising effect on the position of the reader that the concept of authority, particularly the authority of the author and the reader, has been destabilised in the postmodern environment. He suggests that "the effects of authority - and hence the possibility of its existence as event, fact, or concept - depend upon a recognition, in history, by others who will subject themselves to such a Law."[105] This hypothesis applies equally to events as well as people: events must be controlled, they must be contingent on the control of some kind of authority, just as individuals are subject to authority figures and forms of social control. The concept of authority must be viewed as historically contingent, or as Docherty states, "[i]t is in history that authority authorizes itself."[106] The problem with authority in relation to historical systems is that if historical systems are fragmented and destabilised, then the operation of authority also becomes destabilised. Docherty suggests that this is indeed

[101] *Ibid*., p. 17.
[102] Baudrillard, *Cool Memories II*, translated by Chris Turner, Cambridge: Polity Press, 1996, p. 31.
[103] Baudrillard, *The Transparency of Evil*, p. 71.
[104] Thomas Docherty, *Alterities: Criticism, History, Representation*, Oxford: Clarenden, 1996, p. 88. See Baudrillard, *Simulations*, translated by Paul Foss, Paul Patton, and Philip Beitchman, New York: Semiotext(e), 1983, p. 36 (*Simulacres et Simulation*, Paris: Éditions Galilée, 1981).
[105] Docherty, *Alterities*, p. 70.
[106] *Ibid*., p. 70.

the case: "texts, writers, and readers are all fundamentally 'displaced,'" and "[a]s a result, authority is also displaced."[107] Authority or deterrence is recognised by Docherty, as well as by Baudrillard, as a modern occurrence that cannot effectively function in postmodern society.

Baudrillard focuses on the concept of deterrence in *Cool Memories II*, arguing that historical events are no longer subject to control: on the contrary, historical events are "perfect crimes" that are "impossible to reconstruct" - they have no motive, and no perpetrator.[108] The destabilisation of authority represents the consummate failure of the practice of deterrence. Authority is cast into doubt by Baudrillard's appraisal of historical systems with reference to chaos theory, which suggests that as the entirety of an event may never be known, its historical 'reality' may never be verified. Baudrillard demonstrates such an acute interest in the phenomenon of inverse deterrence that he defines three types of disaster that signify its operation. In *The Illusion of the End* he defines the first type as "natural, unforeseeable" disasters. The second type of disaster are "manufactured" and include such events as car crashes and industrial accidents. Baudrillard argues that western society will soon progress towards the third or "pre-programmed" type of disaster which he defines as "deliberate and experimental."[109] He suggests that "paradoxically, it is our pursuit of the means for averting natural catastrophe... which will take us" towards the third stage of catastrophe.[110] In other words, deterrence allows for the proliferation of disasters.

As a consequence of the failure of deterrence, Baudrillard suggests that the ability to predict and interpret events has been drastically reduced, and that the only way to function in postmodern culture is to develop an appreciation of chaos, rather than vainly attempting to deter it. He suggests in *The Transparency of Evil* that "it is useless to appeal to some supposed rationality of the system against that system's outgrowths."[111] It is impossible to function rationally or act authoritatively in the absence of systematised rationality and authority. In *The Illusion of the End* he argues that deterrence

[107] *Ibid*., p. 92.
[108] Baudrillard, *Cool Memories II*, p. 61.
[109] Baudrillard, *The Illusion of the End*, p. 71.
[110] *Ibid*., p. 71.
[111] Baudrillard, *The Transparency of Evil*, p. 67.

"destabilizes prediction" and denies events "meaning or linear end."[112] These events "leave hardly any scope for interpretation" and "evade any desire to give them meaning."[113] In the ambiguous nonlinear causal structures defined by the collapse of determinism and deterrence "the future no longer exists" as a definite entity.[114] It is only by applying the principles of chaos theory to the dynamics of complex open systems that we can develop a new way of discussing indeterminate futures.

Baudrillard's use of chaos theory is significant for two reasons. Firstly, it suggests that explanation of chaotic events is possible only in a distinctly different form to the understanding generated by modern science. He establishes that interpretations of complex social systems must take the operation of chaos into account if any understanding of such events is to be attained, and stresses that recognising that chaos exists is often all that can be achieved. Secondly, his use of chaos theory converges with other critical interpretations of the chaotic dynamics of history, which suggests that his use of chaos theory represents a valuable contribution to recent historiographical considerations of causality. Fundamentally, Baudrillard asserts that to achieve an understanding of chaotic events, critics must examine the cultural signs of chaos and uncertainty.

In *The Transparency of Evil* Baudrillard provides a specific example of this when he discusses the operation of chaos in relation to the spread of HIV and cybernetic viruses:

> The high degree to which AIDS, terrorism, crack cocaine or computer viruses mobilize the popular imagination should tell us that they are more than anecdotal occurrences in an irrational world. The fact is that they contain within them the whole logic of our system: these events are merely the spectacular expression of that system. They all hew to the same agenda of virulence and radiation, an agenda whose very power over the imagination is of a viral character: a single terrorist act obliges a reconsideration of politics as a whole in the light of terrorism's claims; an outbreak of AIDS, even a statistically insignificant one, forces us to view the whole spectrum of disease in the light of the immunodeficiency thesis; and the mildest of computer viruses, whether it vitiates the Pentagon's memory banks or merely erases a shower of on-line Christmas messages, has the potential to destabilize all data contained in information systems.[115]

[112] Baudrillard, *The Illusion of the End*, p. 17.
[113] *Ibid*., p. 19.
[114] *Ibid*., pp. 10-11.
[115] Baudrillard, *The Transparency of Evil*, p. 67.

Baudrillard hypothesises that we must come to terms with the paradoxical nature of deterministic chaos.

Baudrillard's analysis of chaos in historical systems is consistent with other recent applications of chaos theory to historical systems. To give one example, Jonathan Arac points out in *Critical Genealogies: Historical Situations for Postmodern Literary Studies* (1987) that recent historiographical discussions have faltered on the problem of how to conceptualise the ambiguous and discontinuous causality of historical events.[116] Historical events have predominantly been interpreted in causal, linear ways, linking together causes and effects. This practice is methodologically similar to that of classical physics, which relies on a linear causal model where one cause is linked to one effect in an explicit manner. The adoption of this simplistic causal model to 'determine' the origins of historical events has been criticised by Michael Shermer, Frank R. Ankersmit, and David Carr for misrepresenting the complex causal structures of historical systems. They argue that historical events encapsulate the apparent paradox of deterministic chaos: they are deterministic in that situations in the past determine events in the future, yet at the same time historical events are unpredictable and do not follow simple, linear patterns of causality.[117]

The chaologists John Briggs and F. David Peat define the fundamental principle of causality in *Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness* (1989): that the "more complex the system, the farther away cause and effect usually are from each other in both space and time."[118] The problem this creates for the study of historical systems is that the practice of retrospectively identifying the causes of an event become difficult or impossible to achieve. In "The Chaos of History: On a Chaotic Model That Represents the Role of Contingency and Necessity in Historical Sequences" (1993) Michael Shermer argues that if we accept the paradox of deterministic chaos, we therefore acknowledge that as "no cause or set of causes selected as the determiners can be completely known, both history and human action can

[116] Jonathan Arac, *Critical Genealogies: Historical Situations for Postmodern Literary Studies*, New York: Colombia University Press, 1987, p. 5.

[117] For a more thorough examination of this subject see my "The Chaos of History: Notes Towards a Postmodernist Historiography," in *Limina*, Volume 2, 1996, pp. 8-17. This paper is also online at www.arts.uwa.edu.au/HistoryWWW/limina/chaoshist.html (30 Jan 1998).

only be perceived as partially determined."[119] While chaotic systems are deterministic (meaning that their future behaviour is contingent on their past behaviour), their future behaviour cannot be accurately predicted. Historical systems may therefore be defined as systems that are unpredictably determined.

The appropriation of chaos theory principles has enabled historiographers to overcome some of the difficulties associated with studying chaotically determined social systems. Chaos theory offers an alternative to the reductive assumptions of linear historical causality by allowing for seemingly unrelated events to be associated with each other. This practice takes into account the effects of discontinuity and the limited knowledge historians possess about historical events. Applying chaos theory to history suggests that any information may be considered significant; and no detail, however unimportant it appears, can be overlooked in the interpretation of historical events. William V. Spanos argues in *Repetitions: The Postmodern Occasion in Literature and Culture* (1987) that by paying close attention to every insignificant detail associated with an historical event has become an essential part of the historian's methodology. Spanos describes the tiny details of historical systems as "minute particulars" and argues that these "minute particulars, which... include the particulars of historical conjunctures, make a difference" to the analysis of historical events.[120]

Frank R. Ankersmit states a similar case in "The Origins of Postmodernist Historiography" (1994), arguing that the historiographer must be "capable of linking a small, insignificant detail in one part of the work he investigates to an apparently unrelated detail in another part of that work" in order to gain information about and reconstruct meaning out of historical events.[121] He suggests that this reconfiguration of history places higher demands on historiographers than previous historiographical methodologies, for historiographers must be able to adopt and develop a discontinuous

[118] Briggs and Peat, *Turbulent Mirror*, p. 177.
[119] Michael Shermer, "The Chaos of History: On a Chaotic Model That Represents the Role of Contingency and Necessity in Historical Sequences," in *Nonlinear Science Today*, Volume 2, No. 4, 1993, pp. 1-13, p. 3.
[120] William V. Spanos, *Repetitions: The Postmodern Occasion in Literature and Culture*, Baton Rouge: Louisiana State University Press, 1987, p. 241.
[121] Frank R. Ankersmit, "The Origins of Postmodernist Historiography," in *Historiography Between Modernism and Postmodernism*, pp. 87-117, p. 116.

perception of causality.[122] Chaos historiography indicates that circumstances that have been considered unimportant or irrelevant in relation to a specific issue or event may be linked to that event through a nonlinear causal structure. Ankersmit's application of chaos theory for historiography recognises that Lyotard's theory of 'grand narratives' offers a plausible analysis of the structure of history. Lyotard argues that the grand narrative of history has disintegrated into a plurality of small local narratives, resulting in the development of a fragmented, discontinuous pool of information.

Ankersmit establishes from Lyotard that the past has been broken up into many textual elements, and that interpretations of events become relative to one-another.[123] This means that it will become difficult, if not impossible, to discern between what may be termed correct or incorrect, accurate or inaccurate, narrative representations of historical events.[124] Individual texts can only narrate some of the possible interpretations of an event, rather than a complete, authoritative representation of that event, and that different texts will produce differing accounts of particular events. The application of chaos theory to historical systems elucidates a new historiographical approach in which all interpretations of events are contingent not only on the available evidence but on the inability of historians to properly interpret the evidence they possess. Baudrillard makes a crucial contribution to these historiographical developments in several of his texts by elaborating upon how chaos theory has altered the interpretation of causal systems.

The final issue to be considered here is the inconsistent way in which Baudrillard's interpretation of chaos theory has been received by other critics, some of whom are acutely aware of Baudrillard's interest in science and are keen to examine the subject, while others make no reference to it at all. Many critics, even those who appear interested in the issue of Baudrillard's use of science, do not address the issue of chaos theory, however important this theme is in "Fatality or Reversible Imminence" and *The Transparency of Evil*, because they seem to be unaware of its use. Amal Banerjee, for example, examines *L'Illusion de la Fin* in "The Triumph of Chance over Necessity" (1991) and claims that Baudrillard argues that "history sometime looks circular but more

[122] *Ibid*., p. 115.
[123] *Ibid*., p. 89.
[124] *Ibid*., p. 92.

often chaotic."[125] This reference to chaos appears incidental, for it does not specify the context in which Baudrillard uses the term chaos.

Other critics fare no better. Neither Andrew Wernick's "Baudrillard's Remainder" (1993), a review of *The Transparency of Evil*, nor Emma Mason's "Illusion of the End" (c 1996), a review of *The Illusion of the End*, make reference to chaos theory. Wernick discusses Baudrillard's concept of a 'fractal' stage of value, yet does not provide any contextual material to elucidate Baudrillard's use of the term 'fractal.' Like Banerjee, Wernick repeats words used by Baudrillard without examining their context or understanding their significance.[126] Mason similarly does not discuss Baudrillard's application of chaos theory to historical systems in *The Illusion of the End*, despite the fact that Baudrillard clearly defines his view of the relationship between chaos theory and social systems in this text.[127] Wernick's acknowledgment that "[i]t is always difficult to know what to do with a Baudrillard text" underlines the complexity of the ideas presented in *The Transparency of Evil* and *The Illusion of the End*, but it also indicates that Wernick's and Mason's readings do not provide any analysis of Baudrillard's use of chaos theory.[128]

Only Jerry Aline Flieger in "The Listening Eye: Postmodernism, Paranoia, and the Hypervisible" (1996) provides an informed commentary on the operation of chaos and complexity in Baudrillard's texts. Flieger argues that Baudrillard's concept of Evil in *The Transparency of Evil* is "less a moral category than a principle of complexity."[129] He draws attention to Baudrillard conception of complexity and suggests that through its aversion to chaos and complexity society characterises these forces as a form of evil. It is in this context that Flieger acknowledges Baudrillard's interest in chaos theory, noting

[125] Amal Banerjee, "The Triumph of Chance over Necessity," in *Journal of European Studies*, Volume 23, No. 3, 1991, pp. 315-24, p. 316.
[126] Andrew Wernick, "Baudrillard's Remainder," a review of Jean Baudrillard's *The Transparency of Evil: Essays on Extreme Phenomena*, and *Baudrillard Live: Selected Interviews*, edited by Mike Gane. www.ctheory.com/r-baudrillard's_remainder.html (15 Oct 1996).
[127] Emma Mason, "Illusion of the End," a review of Jean Baudrillard's *The Illusion of the End*. www.warwick.ac.uk/fac/arts/English/wip/mas3ii.html (15 Oct 1996). See Baudrillard, *The Illusion of the End*, p. 110.
[128] Wernick, "Baudrillard's Remainder."
[129] Jerry Aline Flieger, "The Listening Eye: Postmodernism, Paranoia, and the Hypervisible," *Diacritics*, Volume 26, No. 1, 1996, pp. 90-107, p. 93. 128.220.50.88/journals/diacritics/v026/26.1er_baudrillard.html (20 Aug 1997).

that "Baudrillard argues that the cataclysm of our posthuman world demands something new from the intellectual, borrowed from chaos theory - the notion of the object as strange attractor..."[130] Of these critiques, only Flieger's acknowledges the predominance of chaos in Baudrillard's recent work. Although none of these critics are prominent in the field of cultural studies, their views may be considered indicative of much of the response to Baudrillard's interpretation of chaos theory.

In comparison, Gane's and Watt's readings of Baudrillard's epistemology of indeterminism are far more perceptive, even though they do not deal extensively with *The Transparency of Evil* or *The Illusion of the End*. Watt and Gane are two critics who make concerted attempts to explain Baudrillard's application of scientific metaphors to cultural systems, especially his application of catastrophe theory to his theory of simulation. They provide perceptive analyses of Baudrillard's use of scientific metaphors and draw attention to the persuasive and problematic aspects of his application of chaos metaphors to social systems. Watt's argument in "Baudrillard's America" that Baudrillard signals the future direction of his critical thought in *The Ecstasy of Communication* and *America* is particularly important: he suggests that both texts indicate that chaos metaphors will become increasingly important in contemporary thought. With the popularisation of chaos theory and its increasing use in literary and cultural studies this analysis has proven correct.

The only criticism that can be leveled against Gane's *Baudrillard: Critical and Fatal Theory* is that it does not focus extensively on Baudrillard's use of chaos theory: Gane is primarily concerned with Baudrillard's fatal theory: he refers to Baudrillard's use of nonlinear science only briefly in his discussion and does not elaborate on many of the implicit conjunctions he discovers. For instance, he discusses Baudrillard's epistemology of uncertainty and his references to "fractal culture" but does not specifically refer to Baudrillard's use of chaos theory in "Fatality or Reversible Imminence" or *The Transparency of Evil*. Furthermore, he refers to Ian Stewart's popular chaos text *Does God Play Dice* but does not go on to discuss convergences between the texts of Stewart and Baudrillard.[131] Gane's reading of Baudrillard's epistemology of indeterminism does

[130] *Ibid*., p. 94.
[131] Gane, *Baudrillard: Critical and Fatal Theory*, p. 170.

not represent a comprehensive critique of the subject, but a promising starting point which suggests that further discussion of Baudrillard's interest in chaos theory is required before its implications are properly understood.

Gane's and Watt's criticisms are especially significant when they are considered together: Watt's description of Baudrillard's 'systemised indeterminacy' complements Gane's portrayal of Baudrillard's 'different order.' Both critics draw attention to Baudrillard's interpretation of the paradoxical nature of deterministic chaos in the construction of his epistemology of indeterminism. The convergence of Gane's and Watt's critical opinions is particularly important because their views were formed in relation to different texts: Gane's discussion of Baudrillard's 'different order' is based on "Fatality or Reversible Imminence" and *The Transparency of Evil* whereas Watt's reading of Baudrillard's 'systemised indeterminacy' is based on *America* and *The Ecstasy of Communication*.[132] Their analogous interpretations of Baudrillard's epistemology of indeterminism testifies to the consistency with which this has been developed and the relevance of the ideas it incorporates.

Baudrillard's use of chaos theory is the most radical, opportunistic, and complex of the three examined in this chapter. Baudrillard makes far fewer concessions to his readers than critics like Lyotard, Hayles, and Porush: his language is convoluted and his uncompromising tone and style contributes to his obfuscation of the scientific origins of chaos theory. Baudrillard challenges his readers to either accept or reject his interpretation and application of chaos theory as they stand; unlike Hayles, Baudrillard does not attempt to justify, legitimatise, or critique his own use of chaos theory, and he does not indicate that he is aware of problems associated with its application to social systems. Further problems emerge when Baudrillard's motivation for appropriating chaos theory are examined. Both Watt and Gane suggest that the application of chaos theory to social systems is not Baudrillard's sole aim, but that his real agenda is to adopt the epistemology of chaos theory as his own. Watt is critical of cultural theory for its "often notorious... reinvention of the wheels of science and mathematics to help convey its own project."[133] This argument is particularly aimed at Baudrillard: Watt proposes

[132] *Ibid*., p. 167. See Baudrillard, "Fatality or Reversible Imminence," pp. 272-93.
[133] Watt, "Baudrillard's America," pp. 141-2.

that readers should question whether Baudrillard adopts chaos theory because he is interested in the similarities between chaos theory and ideas like simulation, or because he perceives chaos theory to be a vehicle to further his ideas.

By obscuring the scientific origins of chaos theory in some of his texts, Baudrillard ignores the intellectual contribution of many chaologists and opens himself to the accusation that he has appropriated chaos theory to make its epistemology his own. Gane draws attention to the ways in which Baudrillard defines his relationships to science and culture, and argues that Baudrillard situates himself between "rationalism and irrationalism," between "scientific and anti-scientific tradition[s]."[134] Baudrillard does not align himself with the discipline of chaos theory, but neither does he identify himself with or within postmodern culture. Instead, he locates his analysis of science and culture from another, unidentified, position, a factor which is in itself extremely problematic, for it is another indication of Baudrillard's unwillingness to make his ideas accessible. Gane's comments on the "radical alterity" of Baudrillard's position from western culture provide a strong justification for questioning the epistemological implications of Baudrillard's writings on chaos theory.[135]

Critics also take exception to Baudrillard's attitude towards chaos and catastrophe. A distinction can be drawn between the ways in which Baudrillard and other critics interpret the concept of chaos. Baudrillard's attitude of *schadenfreude*, defined by Gane as "a malicious enjoyment in the aesthetics of collapse," is at odds with the views of Hayles and Lyotard, who do not celebrate the collapse of complex cultural systems.[136] Baudrillard's *schadenfreude* is particularly evident in *Cool Memories II*, wherein Baudrillard argues that catastrophes arouses *jouissance* in us, and that we should therefore appreciate catastrophes as its cause.[137] Baudrillard's preoccupation with the accident in *Cool Memories II* leads him to suggest that not only are accidents becoming more prevalent, but that they are desirable social events because they absolve people of responsibility and blame. He argues that "we long for things to happen to us which we

[134] Gane, *Baudrillard: Critical and Fatal Theory*, p. 201.
[135] *Ibid*., p. 66.
[136] *Ibid*., p. 207.
[137] Baudrillard, *Cool Memories II*, pp. 48-9.

are not responsible for..."[138] and that '[e]very catastrophe bursts the abscess of collective responsibility."[139] Baudrillard's *schadenfreude* is not limited to his latter texts: it is evident throughout his work, including "Fatality or Reversible Imminence," in which he provocatively suggests that "[t]he only pleasure in the world... is that of watching things head for catastrophe, emerging finally from determinism and indeterminism, from necessity and chance, to enter into the domain of vertiginous interconnections..."[140]

Baudrillard shows through his texts that he is not concerned with conforming to the standards set by other critics, such as the standard of recognising the scientific context of chaos theory. He plays with the referents of chaos, fashioning a complex perception of fluctuating social systems that confounds many of his critics. It is therefore perhaps not very surprising that many critics ignore or avoid the issue of Baudrillard's interest in chaos theory. It should be recognised, however, that interpretations of Lyotard's reading of nonlinear science as paralogy have taken some fifteen years to become established. It may take another fifteen years from the times of the publication of *The Transparency of Evil*, and *The Illusion of the End* before the effects of these texts can be similarly felt.

Baudrillard views the possibility of accepting the catastrophe as the original state of being as immensely historically and culturally significant:

> Prophesying catastrophe is incredibly banal. The more original move is to assume that it has already occurred. This changes all the conditions of the analysis, since it relieves us of the hypothesis of a future catastrophe and of any responsibility towards it.[141]

Baudrillard is not merely concerned with the metaphorical application of chaos theory to social systems: he believes that society is already entirely consumed by the paradox of deterministic chaos and that metaphorical analyses can do nothing to further the understanding of these circumstances. Although made in the context of his comments on *The Inhuman: Reflections on Time*, Flieger's comparison of the differences between Lyotard's optimistic perception of chaos theory and Baudrillard's certainty that chaos is already the prime operative of postmodern culture is telling: "while for Baudrillard, we

[138] *Ibid*., p. 49.
[139] *Ibid*., p. 48.
[140] Baudrillard, "Fatality or Reversible Imminence," p. 285.
[141] Baudrillard, *Cool Memories II*, pp. 68-9.

are already in weightless orbit, in a postcatastrophic, fractal aftermath, for Lyotard our fate is not yet cast, although adumbrated disaster - the end of the species or of the universe - provides a telos for our existence."[142] For Baudrillard, incorporating the principles of chaos theory into critical discourse is imperative because he considers this to be the only effective response to chaos.

SUMMARY

Hayles, Lyotard, and Baudrillard are primarily responsible for the cultural appropriation of chaos theory, and it is therefore appropriate that they provide a vision of the future direction of the project they have initiated. To date, however, an overarching perspective of the literary appropriation of chaos theory and its consequences has not been forthcoming, primarily because of the considerable differences between the interpretations that have been examined here. Hayles is forthcoming in relation to this assessment when she suggests in "Chaos as Orderly Disorder" that "[t]he accommodations, resistances, and convergences that occur between the scientific and literary paradigms indicate how fissured and multilayered the cultural response is to the transvaluation of chaos."[143] The differences between the texts discussed here have produced a haphazard discourse: Hayles, Lyotard, and Baudrillard do not express a consistent or comprehensive interpretation of chaos theory or its application to social systems, and do not indicate how this discourse should develop.

Nevertheless, the texts examined here do contain a set of convergent ideas about the complex dynamics of fictional and social systems. The varying interpretations of chaos theory discussed in them point to the development of a vibrant and innovative new direction in literary criticism and theory. One of the most revealing facets of these texts is that they indicate that literary interpretations of chaos theory have been formulated in relation to literary as well as scientific texts: the literary use of chaos theory has developed with reference to itself, with older interpretations informing newer ones. This self-referentiality has accelerated as more interpretations of chaos theory have been

[142] Flieger, "The Listening Eye," p. 91.

produced, and has made it possible to study the sequential influence that has shaped the literary use of chaos theory. This feedback loop places Lyotard's *The Postmodern Condition* at a pinnacle of influence: it has profoundly impacted, both theoretically and methodologically, on Hayles, Baudrillard, and on many other critics. Perhaps the most significant feature of Lyotard's interpretation of nonlinear science is his methodology of combining catastrophe theory with established aspects of his work, such as his analysis of local and global narratives. By combining chaos theory with established critical ideas Lyotard provides a firm and familiar theoretical foundation on which to ground his application of the principles of nonlinear science to social systems.

This methodology has proven extremely influential, and Hayles and Baudrillard both employ it: Hayles adopts it in her comparison of chaos theory to Derrida's deconstruction; and Baudrillard adopts it by incorporating his interpretation of chaos theory into his theory of simulacra. Through this innovative strategy each theorist opens chaos theory to new literary and cultural contexts. Determining the influence of *The Postmodern Condition* on subsequent texts, however, is not always straightforward. Baudrillard may well have been influenced by *La Condition Postmoderne* and *La Nouvelle Alliance* but there is little direct evidence to confirm this. In contrast to Hayles, Baudrillard does not acknowledge the significance of *The Postmodern Condition* in his texts, although they contain traces of the ideas presented in *The Postmodern Condition*. Given the brevity of this period, it is plausible to consider "Fatality or Reversible Imminence" as a response to these texts, as one link in the development of the cultural interest in chaos theory. The first indicator of this influence is chronological: Baudrillard's interest in chaos theory can be traced back to the period immediately after the publication of *La Condition Postmoderne*.

Gane suggests that Baudrillard's interest in chaos theory originates from "Fatality or Reversible Imminence."[144] His investigations in this area have proven extremely useful in determining that Baudrillard's interest in nonlinear science originates from a point in time after the publication of Lyotard's *La Condition Postmoderne* and Prigogine's and

[143] Hayles, "Chaos as Orderly Disorder," p. 320.
[144] Gane, *Baudrillard: Critical and Fatal Theory*, p. 167. See Baudrillard, "Fatality or Reversible Imminence," pp. 272-93.

Stengers' "La Dynamique, de Leibniz à Lucrèce" and *La Nouvelle Alliance*, but before the popularisation of chaos theory in such texts as Gleick's *New Science*. Through analysis of Baudrillard's epistemology of indeterminism further similarities between Baudrillard's and Lyotard's interpretations of chaos theory become evident. Firstly, Baudrillard's method in "Fatality or Reversible Imminence" is closely comparable to Lyotard's in *The Postmodern Condition*; both refer to prominent scientists to support their appropriations of chaos theory: Baudrillard to Ruelle and Thom, and Lyotard to Thom and Mandelbrot. Secondly, Baudrillard's perception of chaos theory is strikingly similar to that of Lyotard, who suggests that postmodern science theorises "its own evolution as discontinuous, catastrophic, non-rectifiable, and paradoxical."[145]

Baudrillard reflects Lyotard's sentiments when he argues that "[s]cience itself seems to have fallen under the sway of its strange attractors."[146] Both critics consider the phenomenon of deterministic chaos to be an intriguing and highly ironic paradox for science and culture, and suggest that chaos theory is itself chaotically structured, that its theme is reflected through its structure. Like Lyotard, Baudrillard defines deterministic chaos as a paradox which cannot be resolved, only accepted. Lyotard's reading of indeterminism and social systems is similar to Baudrillard's interpretation of historical systems: both propose that deterministic chaos destabilises the ability to predict and interpret historical events. Lyotard's discussion of the power of deterministic chaos to generate blind spots in the interpretation of historical events is reflected in Baudrillard's argument that chaotic events are essentially ambiguous and 'avoid' explanation.

When taking these similarities into account, it is easy to overlook the significant, though not always obvious, differences between these critics. The sophistication of Hayles' interpretation of chaos theory identifies it as the most successful and accessible yet to emanate from the humanities. Hayles favours a cautious approach that involves assessing the implications of chaos theory before endorsing its application to literary criticism. Her comparison of chaos theory and deconstruction is carefully considered and convincing because it takes into account both their similarities and their differences; it demonstrates that the two paradigms are often, though not completely, complementary.

[145] Lyotard, *The Postmodern Condition*, p. 60.
[146] Baudrillard, *The Illusion of the End*, p. 110.

Hayles recognises that the application of chaos theory to further the deconstruction of narrative fictions is problematic given its epistemological status. Her reluctance to fully accommodate chaos theory within critical theory is the result of her consideration of its paradigmatic implications, and the significance of her concerns about the nature of chaos theory cannot be underestimated, especially when the motives of critics like Lyotard and Baudrillard are examined.

Lyotard is optimistic in his approach, and suggests that careful analysis of the principles of chaos theory will confirm that they possess widespread implications for literature and cultural studies. Watt's criticism of cultural theory for its "reinvention of the wheels of science and mathematics" can clearly be leveled against Lyotard and Baudrillard but not against Hayles, who explicitly identifies problems with the literary interpretation of chaos theory while arguing that it does not necessarily subvert either literature of science.[147] It is evident that Lyotard and Baudrillard use chaos theory not to further the cultural understanding of deterministic chaos but to advance their own theoretical frameworks. Although they share an optimistic approach to the appropriation of chaos theory, and are opportunistic rather than cautious in assessing its principles and applying them to social systems, Baudrillard and Lyotard differ over how to properly incorporate chaos theory into critical thought. Whereas Lyotard conforms to conventional notions of intellectual property and recognises the scientific origins the principles of chaos theory, Baudrillard is far less generous: he obfuscates its scientific origins. Further differences emerge when Hayles' and Baudrillard's interpretations of chaos theory are compared. Baudrillard's reading is unconventional and controversial: he explicitly adopts the very policy that Hayles decries in *Chaos Bound*: the celebration of deterministic chaos as destructive disorder. Baudrillard's attitude of *schadenfreude* is at odds with Hayles' critique of the ambiguous connotations of chaos and its reductive implications.

Baudrillard is far less critical of the political implications of chaos theory than Hayles, and is only concerned with its theoretical possibilities: he is neither cautious nor optimistic in his use of chaos theory, but opportunistic. These disparate views all have implications for the ways in which chaos theory is perceived by literature and cultural

studies and the ways in which the literary use of chaos theory is perceived by science. Hayles is explicit in her discussion of the multiplicitous connotations of chaos prevalent in contemporary culture. Unlike Baudrillard, she does not exploit these connotations without recognising the problematics of applying deterministic chaos to social systems accurately. What emerges from this analysis is a critical perception of the legitimacy of literature's use of scientific language. Whereas Hayles remarks that literature's equivocation in relation to chaos complicates its cultural reception, Watt defends Baudrillard's ambiguous use of the terms chaos and catastrophe, suggesting that this is characteristic of many chaologists' use of the language of chaos:

> [In his] at times indiscriminate use of apocalyptic figures of speech to articulate theories that challenge orthodox or positivistic explanations of evolution, Baudrillard follows biologists and mathematicians of the 1970s and early '80s who have exerted the most profound influence on him.[148]

Watt counters Hayles' argument that the manipulation of the multiplicity of chaos will weaken or undermine its legitimacy or applicability and suggests that critics reflect the ambiguity with which chaos has been invested by scientists. Equivocation is central to the representation of chaos theory in literary texts, and as Watt reveals, the ambiguity with which chaos is currently viewed is partially the product of scientific, rather than literary, discourse. The conflict between science and literature over the latter's representation of chaos theory will be further examined in the following chapter.

[147] Watt, "Baudrillard's America," pp. 141-2.
[148] *Ibid*., p. 148.