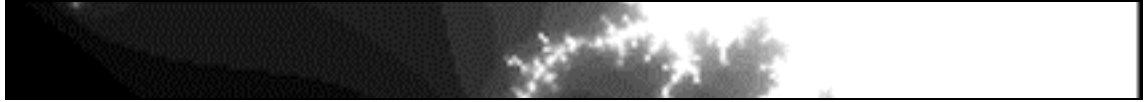


THE POLITICS OF CHAOS THEORY



This chapter will examine the political implications of the literary and cultural interest in chaos theory and the scientific response to this. To critics like Hayles and Lyotard, deterministic chaos is a concept that has significant metaphorical and mythological connotations for literature. Some scientists accept and support literary interpretations of chaos theory, but most view its appropriation in a negative and anxious light and oppose its transvaluation into literature. The literary use of chaos theory has disturbed science's metaphorical equilibrium by expanding the applicability of chaos theory and has subsequently become a controversial subject within science. The controversy surrounding literary interpretations of scientific ideas known as the 'science wars' is a prominent theme in contemporary cultural studies.

The first section of this chapter will examine critical claims regarding the epistemological status of chaos theory. David S. Porush, William R. Paulson, Peter Stoicheff, and Philip Kuberski advance individual though complementary arguments that the convergence of postmodernism and chaos theory necessarily incorporates the convergence of their epistemological authorities. They use the idea of the convergence of chaos theory and postmodernism to appropriate the epistemological authority of science so that they can authoritatively examine the chaotic nature of reality through literature. Literary claims to science's epistemological authority via chaos theory culminate in Paulson's assertion in *The Noise of Culture* (1994) that literature is equivalent to chaos theory in its ability to examine and explain chaotic phenomena. Implicit in this claim is the idea that fictional and literary worlds are as important as the 'real world' and as worthy of study. The ideas summarised in this section provide the essential context for the substance of this chapter - the debate between science and literature regarding the nature of chaos theory and its applicability to literature.

The second section will examine how literary criticism has come to view the discourse of chaos theory as fragmented and politically motivated. Hayles argues that

“the history of chaos theory has scarcely begun to be written, [but] it has already become problematic.”¹ She suggests that deep philosophical divisions exist within chaos theory, and that these divisions indicate that it does not represent a unified ‘grand narrative’ of science but a cultural discourse with explicit political characteristics. Hayles argues that there are two distinct groups within chaos theory: the first group, led by Ilya Prigogine, supports the interpretation of its ideas; whereas the second group, comprised of a number of American chaologists, firmly opposes such developments. Porush focuses on one manifestation of this fragmentation - the exclusion of Ilya Prigogine from much of the North-American chaos theory literature - and argues that scientists who acknowledge similarities between chaos theory and the humanities are treated with suspicion and hostility by their fellow scientists and become isolated from the political centre of chaos theory because of their views. Prigogine’s methodology - which combines scientific research and philosophical speculation - is a striking example of the interdisciplinary possibilities of the worldview of chaos theory, yet it is considered by scientists like Gross and Levitt to conflict with the purported objectivity and methodological purity of science.

The idea that science is an objective discipline that must isolate itself from social concepts like constructivism and relativism in order to function is dismissed by Porush, who notes that those who maintain the “canons of objectivity and impersonality are still hostile” to alternative approaches to the practice of science.² He asserts that personal and political reasons, rather than academic reasons, explain why Prigogine has been positioned on the periphery of chaos theory by some of his colleagues. With reference to Gaston Bachelard’s perception of scientific discourse, Andrew Gibson argues in *Towards a Postmodern Theory of Narrative* (1996) that “science constantly resorts to the imagination and traffics in the world of images, in a discourse that is radically other to the discourse that it tells us is its own.”³ A literary interpretation of the discourse of chaos theory indicates that it does not differ substantially from the subjective standards and modes of other discourses.

¹ Hayles, *Chaos and Order*, p. 12.

² Porush, “Making Chaos,” pp. 158-9.

³ Andrew Gibson, *Towards a Postmodern Theory of Narrative*, Postmodern Theory Series, Edinburgh:

The third section will examine how literature's use of chaos theory has been viewed by scientists. In his Introduction to Prigogine's and Stenger's *Order out of Chaos* Alvin Toffler argues that the principles of chaos theory have "at least analogical significance" for society, and that science is currently engaging in a "new dialogue... with society."⁴ In contrast, scientists like Paul R. Gross and Norman Levitt argue in *Higher Superstition: The Academic Left and Its Quarrels with Science* (1994) that chaos theory has at most metaphorical significance for the humanities, and that claims made about its relevance to social systems are exaggerated and almost wholly unsubstantiated. The debate within chaos theory concerning its philosophy, methodology, and interdisciplinary implications, and the corresponding clash between those who claim to represent science and the humanities concerning the literary use of chaos theory, are examples of the 'science wars.' Literature's use of chaos theory has been interpreted within science as an attack rather than as a form of genuine interest. This section will consider science's response to this supposed attack, and how literature has in turn responded to the scientific critique of its use of chaos theory.

EPISTEMOLOGY

This section will examine claims made by critics regarding the epistemological implications of the application of chaos theory to literature. William R. Paulson, Peter Stoicheff, David S. Porush, and Philip Kuberski counter Hayles' cautious interpretation of chaos theory by proposing two radical ideas: firstly, that chaos metaphors may be directly applied to novels and other literary texts; and secondly, that postmodern literature's epistemology, like that of chaos theory, exceeds the epistemology of modern science. Although these critics maintain that the analogous description of literary ideas in relation to chaos theory is important, they also submit that chaos theory may be applied directly to texts by defining them as models of chaotic systems. Porush contends that narratives possess at least as much epistemological potency as modern science, that metafiction is able to describe complexity as coherently as chaos theory, and that they

are therefore analogous to chaos theory in that both describe 'reality' more effectively than modern science.

Porush's ideas are represented in a series of overlapping papers. "Making Chaos: Two Views of a New Science" (1990) provides contextual information and outlines how literature has received the ideas of Ilya Prigogine. "Prigogine, Chaos, and Contemporary Science Fiction" (1991) examines how the theme of chaos theory is represented in science fictions. "Fictions as Dissipative Structures: Prigogine's Theory and Postmodernism's Roadshow" (1991) further examines the material from "Making Chaos. "Literature as Dissipative Structure: Prigogine's Theory and the Postmodern 'Chaos' Machine" (1992) is theoretical and does not engage in a critical discussion of the fictional representation of chaos theory: rather, it examines its use in literary criticism and its implications for literary theory.⁵

Porush argues that modern science possesses a very limited capacity to describe complex phenomena, and that chaos theory is far more suited to this purpose. Porush is concerned with demonstrating that fictional texts are chaotic and follow the same forms of chaotic order as other open systems. He argues that narratives and chaos theory refer to similar principles and concepts to describe the world. His appropriation of chaos theory is designed to accommodate literary texts within the set of systems which may be studied by chaos theory. It is for this reason that he claims in "Fictions as Dissipative Structures" that "the postmodern novel is at a point in the evolution of literary technique that it actually is able to reflect and capture how phenomena like the mind or social organisation of human decision-making processes or traffic work."⁶ Complex systems like social organisation and traffic are commonly studied by chaologists and are considered typical examples of chaotic systems. By arguing that novels define how these systems function as accurately as other texts, Porush is able to claim that novels contain

⁴ Toffler, Foreword to *Order out of Chaos*, pp. xv, xvii.

⁵ Porush acknowledges that he "takes a certain liberty with the notion of a literary text by speaking of it in the abstract rather than concentrating on particular examples." This defines the structural approach adopted by many critics in their application of chaos theory to literary criticism. See Porush, "Literature as Dissipative Structure: Prigogine's Theory and the Postmodern 'Chaos' Machine," in *Literature and Technology*, edited by Mark Greenberg and Lance Schachterle, Research in Technology Studies 5, Bethlehem: Lehigh University Press, 1992, pp. 275-306, p. 277.

⁶ Porush, "Fictions as Dissipative Structures," p. 76.

valuable information about chaos, and that they should be studied with reference to chaos theory.

Porush argues that novels have an advantage over scientific texts in defining and explaining chaos because the language of literature is more evocative and descriptive than the language of science, which Porush describes in “Literature as Dissipative Structure” as “constrained, logical, and naively realistic.”⁷ He suggests that “literature appears to have an advantage over science in describing macroscopic processes, including human behaviour, as it really occurs.”⁸ Literature’s strength in describing chaotic events is such that Porush states that “describing cultural productions as dissipative structures is more than metaphorical.”⁹ He suggests that the novel is able to describe complex social systems so effectively because it “applies and demonstrates scientific principles” in order to achieve “the most potent possible description of reality.”¹⁰ He argues in “Prigogine, Chaos, and Contemporary Science Fiction” that by adopting the principles of chaos theory, literature can “lay some claim to doing a better job of describing some kinds of reality” than science.¹¹ Fictional texts are therefore more effective than the texts of modern science in describing complex phenomena.

These are extremely ambitious claims which, because they exceed the arguments used to substantiate them, are difficult to validate. The challenge of affirming Porush’s ambitious use of chaos theory is met more by a separate collection of critics - Kuberski, Stoicheff, and Paulson - than by Porush himself. These critics support Porush’s assertion that literary texts have at least as much epistemological authority as scientific texts. Firstly, in *Chaosmos: Literature, Science, and Theory*, Kuberski defends Porush’s hypothesis that the exploration of chaos in novels is analogous to science’s study of it:

the play of determinacy and indeterminacy is everywhere, from the shifting patterns and molecules in our bodies to the circulation of signifiers that form the shifting patterns of human science, language, history, and criticism. Whether one turns to Werner Heisenberg,

⁷ Porush, “Literature as Dissipative Structure,” p. 284.

⁸ *Ibid.*, p. 300.

⁹ *Ibid.*, p. 294.

¹⁰ *Ibid.*, p. 277.

¹¹ Porush, “Prigogine, Chaos, and Contemporary Science Fiction,” in *Science Fiction Studies*, Volume 18, No. 3, 1991, pp. 367-86, p. 372.

James Joyce, Jacques Derrida, or Lao Tsu, one sees this interpretation of disorder and order, chance and necessity.¹²

By considering Heisenberg, Joyce, and Derrida to be equally involved in the examination of chaos, Kuberski suggests that the epistemology of literature as equivalent to that of science.

Kuberski suggests that literature is not the opposite of science but its partner. He affirms Porush's idea that social and fictional systems are literally open systems:

Texts... which abandon the linear and abstracting tendencies of modern literature, show how chaos and cosmos can be reconciled and yet appreciated distinctly within the dynamics of a multi-leveled, multitemporal, plurivocal language whose surplus of meaning begins to resemble the 'noisy' but engendered status of chaos.¹³

Literary texts do not simply reflect chaos - they enact and embody it. Kuberski argues that "[a] literary work is not a 'solid-state' artefact but an ongoing and self-transforming activity, similar to a vortex which thrives by drawing upon its environment to sustain its own immaterial form."¹⁴ To Kuberski, "the deterministic and the noisy aspects of literary texts enact the cosmic and chaotic functions of the living world and lived experience."¹⁵ In other words, deterministic chaos is a facet of reality that is as prevalent in fictional systems as in any other type of system. Stoicheff forwards a similar argument to Porush concerning the comparative epistemological authorities of science and literature. He argues in "The Chaos of Metafiction" that the process of defining narratives as open systems constitutes a new way of reading the world.¹⁶ To Stoicheff, reading novels is analogous to reading the world because they embody the chaotic nature of reality as effectively as any other system. He hypothesises that novelistic chaos and the chaos of the world are simply two examples of the same phenomenon.¹⁷

This argument is also advanced by Paulson in *The Noise of Culture*. Paulson contributes to literature's reconfiguration of the relationship between itself and science by providing another explanation of its ability to develop knowledge about chaotic

¹² Kuberski, *Chaosmos*, p. 2.

¹³ *Ibid.*, p. 47.

¹⁴ *Ibid.*, p. 47.

¹⁵ *Ibid.*, p. 47.

¹⁶ Peter Stoicheff, "The Chaos of Metafiction" in *Chaos and Order*, pp. 85-99, p. 85.

¹⁷ *Ibid.*, p. 94.

systems. Paulson hypothesises that defining narrative as open systems represents a new form of reading the world:

Literature, with its exploitation of language's ambiguity... places us in immediate contact with a complex system of relations, a system that we can neither reduce to something simpler nor account for by adding together simple things. To read as fully as possible the literary text, we need codes that we do not at the outset possess, because only by experiencing the text's complexity can we begin to construct them. Literature, and to an even greater extent its study, can thus constitute the cultural apprenticeship of a science or knowledge of the complex.¹⁸

Fictional and theoretical literary texts contribute to the exploration of chaotic systems by developing an understanding of these systems that is analogous to science's. This claim is made with the intention of establishing the potency of literature's epistemology, not of belittling the practice of science. In the process, however, literature has introduced a critique of the methodology of science and the duplicity of its discourse that appears highly antagonistic to many scientists. The following sections will define this critique and consider its consequences.

POLITICS

One focus of the literary interest in chaos theory is to critically examine the popular texts of chaos theory. These texts represent the history and science of chaos theory in different ways, and the discrepancies they reveal have been interpreted by critics who view them as evidence of struggles between chaologists for authority within their discipline. Critics question how a supposedly objective, truth-oriented scientific discourse has written its own history in such a subjective, politically charged manner. Hayles and Porush in particular are intrigued by the internal politics of chaos theory. This section will examine the political undertones of the popular texts of chaos theory. Hayles argues in *Chaos Bound* that chaos theory is ideologically divided into two branches: the 'philosophical' branch, and the practical or 'applied' branch.¹⁹

The philosophical or 'order-out-of-chaos' branch is represented by the 'grandfathers' of chaos theory and catastrophe theory - Ilya Prigogine and René Thom -

¹⁸ Paulson, *The Noise of Culture*, p. 143.

and combines a rigorous ‘scientific’ methodology with a philosophical and speculative approach to chaos and complexity.²⁰ Hayles describes the philosophical branch as “overtheorized” in that it endeavours to extrapolate conclusions from experimental and unconfirmed findings: she recognises that Prigogine “has strong ties with French intellectual circles, and the order-out-of-chaos branch is known for its willingness to extrapolate beyond experimental results to philosophical implications.”²¹ The philosophical branch of chaos theory encourages literary interpretations of its ideas; Prigogine and Stengers argue that “[t]he ideas to which we have devoted space in [*Order Out of Chaos*] - the ideas of instability, of fluctuation - diffuse into the social sciences.”²² Toffler argues in his Introduction to *Order out of Chaos* that the “analogical extension” of chaos theory into the humanities is considered by Prigogine to be an expected and appropriate cultural development of his science.²³ A further distinguishing feature of this branch of chaos theory is its critical perspective of the ideology and history of science - *In Order out of Chaos*, for example, Prigogine and Stengers discuss the “myth underlying modern science” and critically evaluate its mechanistic, reductionist methodology.²⁴

The views of the applied or ‘order within chaos’ branch of chaos theory are expounded by Benoit Mandelbrot, Edward N. Lorenz, Mitchell Feigenbaum, Robert Shaw, and Stuart A. Kauffman, as well as by science writers and journalists like Gleick, Lewin, and Waldrop.²⁵ The applied branch of chaos theory considers philosophical and

¹⁹ Hayles, *Chaos Bound*, p. 9.

²⁰ The primary texts of the philosophical branch of chaos theory include Prigogine’s and Stenger’s *Order out of Chaos*; Stewart’s *Does God Play Dice?*; Briggs’ and Peat’s *Looking Glass Universe: The Emerging Science of Wholeness*, London: Fontana, 1985, and *Turbulent Mirror*; Davies’ and Gribbin’s *The Matter Myth*; A. B. Cambel’s *Applied Chaos Theory: A Paradigm for Complexity*, San Diego: Academic Press, 1993; Goerner’s *Chaos and the Evolving Ecological Universe*, Pennsylvania: Gordon and Breach, 1994; and Prigogine’s and Stenger’s forthcoming *The End of Certainty: Time, Chaos, and the New Laws of Nature*, Free Press, 1997.

²¹ Hayles, *Chaos Bound*, p. 10.

²² Prigogine and Stengers, *Order Out of Chaos*, p. 312.

²³ Toffler, Foreword to *Order out of Chaos*, p. xxiii.

²⁴ Prigogine and Stengers, *Order Out of Chaos*, p. 51.

²⁵ Hayles, *Chaos Bound*, p. 10, and *Chaos and Order*, p. 12. The texts of the applied branch of chaos theory include Mandelbrot’s *Fractals: Form, Chance and Dimension*, and *The Fractal Geometry of Nature*; David Ruelle’s *Chance and Chaos*, Princeton: Princeton University Press, 1991; Lorenz’s *The Essence of Chaos*; Casti’s *Complexification*; Stuart A. Kauffman’s *The Origins of Order: Self-Organization and Selection in Evolution*, New York: Oxford University Press, 1993, and *At Home in the*

cultural representations of scientific theories to be wholly inappropriate; Hayles describes it as “undertheorized; its practitioners prefer to concentrate on problems of immediate practical interest.”²⁶ Applied chaologists commonly adopt a dry discursive style which minimises the use of metaphors; they discuss technical applications of chaos theory to physical and economic systems and discourage the tentative social applications of chaos theory that Prigogine and Stengers optimistically hint at in *Order Out of Chaos*. Moreover, the applied branch of chaos theory appears far less interested in examining the strengths and weaknesses of the ideology and methodology of modern science.

Hayles outlines a number of ways that the two branches of chaos theory may be distinguished. The first is by the way they describe chaotic systems. She argues that Prigogine stresses “the spontaneous emergence of self-organization from chaos” whereas the applied branch of chaos theory focuses on “the hidden order that exists *within* chaotic systems.”²⁷ This differentiation is problematic because it hinges on descriptive terms rather than on methodological frameworks. Porush argues in “Making Chaos” that the two branches’ descriptions of chaotic systems describe the same set of circumstances:

the territory Prigogine explores is virtually the same territory explored by Gleick and his subjects, so much so that one could safely say that the same ‘facts’ are being explained. However, they are reconstituted from the perspective of a different version of science’s role, and thus the two explanations come to strikingly different conclusions and portray very different applications.²⁸

Both branches of chaos theory examine deterministic chaos, but they adopt disparate methodologies and subsequently employ different terms.

What is more significant about the popular texts of chaos theory to literary readers is the extent to which these texts employ metaphors to explain their subject. The philosophical branch of chaos theory integrates scientific discoveries into a human-oriented worldview in its texts by making extensive use of metaphors which relate chaos theory principles to social systems. In so doing these texts effectively conform to literary

Universe: the Search for Laws of Self-Organization and Complexity, London: Viking, 1995; Gleick’s *New Science*; Lewin’s *Complexity: Life at the Edge of Chaos*; and Waldrop’s *Complexity: The Emerging Science at the Edge of Order and Chaos*.

²⁶ Hayles, *Chaos Bound*, p. 10.

²⁷ *Ibid.*, p. 9.

²⁸ Porush, “Making Chaos,” pp. 157-8.

conventions, and this makes them attractive and accessible to literary readers. The significance of this approach, for as Gillian Beer argues, Darwin's use of metaphors in *The Origin of Species* "allowed it to be appropriated by thinkers of so many diverse political persuasions. It encouraged onward thought: it offered itself for metaphorical application and its multiple discourses encouraged further acts of interpretation."²⁹ Beer's comments provide an apt description of the ability of the philosophical branch of chaos theory to encourage the development of a literary context for chaos theory.

Prigogine is referred to by the literary interpreters of chaos theory above all other chaologists because *Order out of Chaos* conforms to literary and cultural conventions more than other popular science texts. In *Order out of Chaos* Prigogine and Stengers refer to H. G. Well's *The Time Machine*, Vladimir Nabokov's "Look at the Harlequins," and Goethe's *Faust*, and use these references to expound upon the philosophical implications of chaos theory.³⁰ *Order out of Chaos* places the development of chaos theory within the context of the history of ideas and as well as the history of science, and refers to Kierkegaard, Kant, Heidegger, Hegel, Whitehead, Nietzsche, and Serres.³¹ Each of these references functions to domesticate chaos theory within the humanities. One of the significant features of *Order out of Chaos* is that it acknowledges that science has always used metaphors and other forms of creative expression in order to make its concepts and hypotheses intelligible. Prigogine and Stengers discuss two of the most significant scientific metaphors - 'Schrödinger's cat' and 'LaPlace's Demon' - and argue that the "inspired discourse" of science produces a "prophetic announcement of a description of the world."³² *Order out of Chaos* exemplifies this style of scientific discourse.

In comparison, although they are not devoid of literary allusions, applied chaos theory texts do not match Prigogine's and Stengers' literary sophistication. The texts written by journalists and science writers fare best in this regard: Gleick refers to John Fowles' *A Maggot* in *New Science*, and Lewin mentions Lewis Carroll's *Through the*

²⁹ Beer, *Darwin's Plots*, p. 100.

³⁰ Prigogine and Stengers, *Order out of Chaos*, p. 77 (Well's *The Time Machine*), pp. 277-8 (Nabokov's "Look at the Harlequins"), and p. 128 (Goethe's *Faust*).

³¹ *Ibid.*, pp. 79, 104, 136, 141, 320.

³² *Ibid.*, p. 76.

Looking Glass in Complexity: Life at the Edge of Chaos.³³ Among the applied chaologists themselves, only Casti in *Complexification* makes substantial use of literary references, discussing Mark Twain, Joseph Heller's *Catch-22*, Shakespeare's *A Midsummer Night's Dream*, and Jorge Luis Borges' "The Library of Babel."³⁴ Casti also establishes innovative applications of catastrophe theory and chaos theory, such as using it to predict the fall of the Berlin Wall and the examination of the collapse of ancient civilisations by the archaeologist Colin Renfrew.³⁵ The texts of applied chaos theory are far less effective in domesticating chaos theory within culture than the texts of the philosophical branch of chaos theory.

With the exception of Casti's *Complexification*, the difference between applied and philosophical chaos theory texts is that the former do not use literary and philosophical ideas to provide a strong social context for the scientific ideas they represent. Such literary, philosophical, and political comparisons are however essential to the cultural domestication of chaos theory, for they represent points of convergence between science and the humanities. Each literary reference defines a moment of convergence between science and the humanities, and indicates that scientists as well as critics and theorists are considering the impact of science and culture on each other. The scientific recognition of points of convergence between chaos theory and the humanities is crucial to the literary and cultural interest in it, and functions as an implicit acknowledgment of the validity of this interest.

While this analysis of the distinguishing characteristics of the two branches of chaos theory and their texts is useful in understanding why the philosophical branch of chaos theory has had a greater impact on literature than the applied branch, this in itself is insufficient to explain the extent of the differences between the two. Chaos theory's internal conflict is down-played in many of the popular texts of chaos theory, which generally assert that chaos theory is one broad discipline.³⁶ For example, Gleick suggests

³³ Gleick, *New Science*, p. 117; Lewin, *Complexity*, p. 58.

³⁴ Casti, *Complexification*, pp. 171-2 (Twain), p. 184 (Heller's *Catch-22*), pp. 191-3 (Shakespeare's *A Midsummer Night's Dream*), and p. 289 (Borges' "The Library of Babel"). See Jorge Luis Borges, "The Library of Babel," in *Labyrinths*, London: Penguin, 1970.

³⁵ Casti, *Complexification*, p. 48 (Berlin Wall) and p. 73 (archaeology). The application of chaos theory to archaeology will be examined in "The Chaotic Environment."

³⁶ Prior to the development of the science wars, science's internal conflicts have not been commonly

in *New Science* that from the beginnings of chaos theory, American and European scientists have worked closely together: “in the 1970s a few scientists in the United States and Europe began to find a way through disorder. They were mathematicians, physicists, biologists, chemists, all seeking connections between different kinds of irregularity.”³⁷ Critics do not challenge the notion that chaos theory is one discipline: what they do question is the assumption that it is a united discipline. Hayles and Porush assert that scientific differences between chaologists are rare, but that widespread philosophical and political differences are played out in the popular texts of chaos theory.

A more effective means for assessing the differences between the two branches of chaos theory is to consider the case of Ilya Prigogine. Prigogine is greatly admired in the humanities for his efforts to explain his science to a popular audience, yet his work is often dismissed by his contemporaries with the accusation that it is overly philosophical and that it lacks the precision of good science. Considering that Prigogine is the only man to have thus far won the Nobel Prize for work related to nonlinear dynamics, the extent to which his ideas are ignored may be interpreted as significant in itself. The literary interpreters of chaos theory argue that applied chaologists and the science writers associated with them have adopted an ‘anti-Prigogine policy’ that has resulted in the exclusion of Prigogine’s contribution to chaos theory from many popular texts. Prigogine is consistently excluded from popular chaos theory texts written by science writers associated with the applied branch of chaos theory.

Porush argues in “Making Chaos” that this exclusion is particularly obvious in Gleick’s *New Science*. Gleick ignores the achievements of Prigogine, and mentions him only in an obscure endnote.³⁸ Lewin’s *Complexity: Life at the Edge of Chaos* also does not acknowledge Prigogine. Gleick and Lewin favour the work of American chaologists like Stuart A. Kauffman, Doyne Farmer, Norman Packard, and James Crutchfield in their texts.³⁹ Casti in *Complexification* similarly excludes any mention of Prigogine. Only

examined in popular texts. One exception is Prigogine’s and Stengers’ mention of Michel Serres’ study of why scientists “quarrel or remain unable to communicate with each other.” See *Order out of Chaos*, p. 76.

³⁷ Gleick, *New Science*, pp. 3-4.

³⁸ *Ibid.*, p. 339, endnote 308.

³⁹ *Ibid.*, p. 248. These chaologists are famous for their 1986 *Scientific American* article: see James P. Crutchfield, Doyne Farmer, Norman Packard, and Robert Shaw, “Chaos,” in *Scientific American*,

Waldrop in *Complexity: The Emerging Science at the Edge of Order and Chaos* discusses Prigogine's ideas and his contribution to chaos theory.⁴⁰ Waldrop is unique amongst the science writers associated with applied chaos theory in that he hints at his political agenda, suggesting that he is only interested in recounting the "story" of the chaologists associated with the American chaos theory research centre known as the Santa Fe Institute.⁴¹

Critics of *New Science* have drawn attention to its political under-tones and theoretical limitations. Donald Worster in *The Wealth of Nature: Environmental History and the Ecological Imagination* (1993) denounces Gleick for not exploring "the striking intellectual parallels between chaotic theory in science and post-modern discourse in literature and philosophy" in *New Science*.⁴² This critique is mild in comparison to Charles Dyke's reading of Lewin's *Complexity: Life at the Edge of Chaos* and Waldrop's *Complexity: The Emerging Science* as "scientific soap opera."⁴³ Dyke argues that these texts treat their readers "like children," and underestimate the "competent, intelligent, conscientious enthusiasts of new developments in science."⁴⁴ Dyke is not concerned with the issue of the exclusion of Prigogine from many chaos texts, but his critique affirms the arguments of Hayles and Porush in relation to this issue. Gleick, Lewin and Waldrop underestimate the intelligence of their audience, misrepresent and distort the history of chaos theory, ignore or misrepresent the role of Prigogine in the formation of the discipline, and contribute to the literary perception of chaos theory as a fragmented discipline.

Examining the exclusion of Prigogine involves considering the institutional, nationalistic, and philosophical implications of chaos theory. Hypotheses detailing institutional, nationalistic, and philosophical circumstances will be examined to explain how and why the exclusion of Prigogine from the canon of chaos theory has occurred.

Volume 255, 1986, pp. 38-49.

⁴⁰ Waldrop, *Complexity: The Emerging Science*, pp. 32-5.

⁴¹ *Ibid.*, p.12-13.

⁴² Donald Worster, *The Wealth of Nature: Environmental History and the Ecological Imagination*, New York: Oxford University Press, 1993, p. 237, Footnote 28.

⁴³ Charles Dyke, "Book Reviews," in *Configurations*, Volume 2, No. 3, 1994, pp. 576-8, p. 576. 128.220.50.88/journals/configurations/v002/2.3br_kauffmann.html (20 Aug 1997).

⁴⁴ *Ibid.*, p. 576.

Firstly, the institutional explanation for the exclusion of Prigogine from the canon of chaos theory will be assessed. As is the case with many sciences, university and independent research centres drive the development of chaos theory. The research centres which produce the best ideas and experimental results, and which publish the most influential texts, receive the greatest financial and professional rewards. Considering the allegiances of the most important chaos research centres in relation to the two branches of chaos theory is helpful in coming to understand how Prigogine has been marginalised by applied chaos theory. Gleick, Lewin, and Waldrop describe the work of chaologists like Casti, Kauffman, Farmer, Packard, and Crutchfield, who are associated with two American research centres: the private Santa Fe Institute and the government-funded Los Alamos National Laboratory which incorporates a Centre for Nonlinear Systems.⁴⁵ The Santa Fe Institute (SFI) is discussed by Lewin, Waldrop, and Casti, who is a member of the External Faculty of the SFI.⁴⁶ Prominent chaologists associated with the SFI include Per Bak, James Crutchfield, Murray Gell-Mann, Stuart A. Kauffman, and Christopher Langton.⁴⁷ For example, Waldrop describes the SFI as the “nerve center” of chaos theory and glorifies its achievements without providing comparative evidence of its focal nature to the chaos theory confraternity.⁴⁸

Toffler notes in his Introduction to *Order out of Chaos* that Prigogine is associated with the “Ilya Prigogine Centre for Statistical Mechanics and Thermodynamics at the University of Texas in Austin.”⁴⁹ The centre with which Prigogine is associated may be regarded as a rival to the SFI and the LANL in terms of academic prestige and research funding.⁵⁰ Prigogine’s authority as a visiting scholar at the University of Texas, complete with Nobel Prize, speaks for itself, and equals in prestige terms the SFI’s Nobel winning Murray Gell-Mann.⁵¹ It is plausible to suggest that

⁴⁵ Waldrop, *Complexity: The Emerging Science*, p. 67.

⁴⁶ The SFI External Faculty page is at www.santafe.edu/sfi/organization/external-faculty.html (20 Aug 1998).

⁴⁷ See the SFI web-pages at www.santafe.edu/ (20 Aug 1997).

⁴⁸ Waldrop, *Complexity: The Emerging Science*, pp. 12, 325, 339. See also Gleick, *New Science*, p. 155.

⁴⁹ Toffler, Foreword to *Order out of Chaos*, p. xi.

⁵⁰ The competitive nature of scientific research is mentioned by Waldrop, who speaks of the SFI’s pressing need for federal government grants “from the National Science Foundation and the Department of Energy.” See *Complexity: The Emerging Science*, pp. 247-8.

⁵¹ Lewin, *Complexity*, p. 15; Waldrop, *Complexity: The Emerging Science*, p. 53.

applied chaos theorists, such as those associated with the SFI, do not refer to Prigogine in their texts because to do so would give a competitor and rival something akin to free advertising. The institutional argument provides a cogent reason for the exclusion of Prigogine from many of the pivotal texts of applied chaos theory, and demonstrates that the economic competitiveness of academic institutions can limit the objective representation of scientific ideas. The institutional argument does not, however, provide a comprehensive explanation of the differences between Prigogine and the applied chaologists.

A second hypothesis which may explain the fragmentation of chaos theory is based on nationalistic sentiments. Porush argues in “Making Chaos” that nationalistic and geographic factors have played a part in establishing the divisions within chaos theory: he suggests that applied chaologists are predominantly American, whilst philosophical chaologists tend to be European. This argument is simplistic and inaccurate: some American chaologists may be philosophically-oriented, while it is obvious that not all of the applied chaologists are American. Mandelbrot, for example, is European, yet he is considered to be a leader of the applied branch of chaos theory. The exceptions to the division of chaos theory on national lines are too significant to make it useful. Nevertheless, ideas of nationalism contribute to the divisions within chaos theory.

To give an example of how inaccurate ideas of national favouritism influence chaos theory, Porush refers in “Making Chaos” to a discussion between himself and Prigogine, during which Prigogine suggested that Gleick was predominantly interested in promoting the work of American, not European, scientists in *New Science*, and that his ideas were excluded from *New Science* for this reason.⁵² Porush is suspicious of this explanation, and for good reason: Prigogine’s explanation is manifestly unconvincing, especially when his appointment at the University of Texas is considered. While he was born in Russia, Prigogine has lived most of his life in the west: Toffler points out that Prigogine was “[b]orn in Russia in 1917 and raised in Belgium since the age of ten,” and that he “spends part of each year at the Ilya Prigogine Centre for Statistical Mechanics and Thermodynamics at the University of Texas in Austin.”⁵³ It is difficult to accept

⁵² Porush, “Making Chaos,” p. 159.

⁵³ Toffler, Foreword to *Order out of Chaos*, p. xi.

Prigogine's belief that his European origins explain his exclusion from the canon of chaos theory. It is clear that Prigogine has strong American associations, and that other reasons must account for his exclusion from the canon of chaos theory.

The third explanation for Prigogine's exclusion takes into account the philosophical differences between the two branches of chaos theory. Porush suggests that these differences explain why Prigogine has been excluded from many popular chaos theory texts. He argues that Gleick's peculiar attitude towards Prigogine in *New Science* is indicative of the politically and philosophically motivated discourse of chaos theory: Gleick's description of Prigogine's "highly individual, philosophical view of the relationships between thermodynamics and dynamical systems" is a condescending dismissal of Prigogine's scientific achievements.⁵⁴ Porush claims that Gleick deliberately misrepresents the extent of Prigogine's involvement in the history of chaos theory, and that his portrayal of Prigogine as an individualistic, radical scientist is explicitly designed to contribute to Prigogine's "excommunication from the church of science."⁵⁵

The extent to which the image of Prigogine has been tainted by his reputation for philosophical speculation will be further considered in the following section, but for the sake of the argument here it is sufficient to recognise that Gleick's analogy of science as a church implies that its discourse is not purely rational. The institutional and philosophical arguments offer compelling explanations for the exclusion of Prigogine from the canon of chaos theory, for they demonstrate that the dynamics of academic politics have played a large part in determining the extent to which Prigogine's ideas have been incorporated into the history of chaos theory. Hayles asserts in *Chaos Bound* that chaos theory is a "deeply fissured" discipline.⁵⁶ This discussion suggests that chaos theory has fissured as a result of internal pressures and conflicts.

⁵⁴ Gleick, *New Science*, p. 339, endnote 308.

⁵⁵ Porush, "Making Chaos," p. 158.

⁵⁶ Hayles, *Chaos Bound*, p. 174.

THE COUNTER-CRITIQUE

Critics are fascinated by the contested dynamics of the highly charged discourse of chaos theory, and have transformed what was a struggle for authority and legitimacy within chaos theory to a debate between science and the humanities concerning the legitimacy of literary interpretations of scientific ideas. Applied chaologists and other scientists who support the isolationist ideology of modern science argue that far from diffusing into the social sciences and the humanities, the principles of chaos theory have been forcefully appropriated to create an illogical and unproductive union with literary and cultural studies. They argue that this discursive union is unconvincing and inappropriate because critics are incapable of comprehending the principles of chaos theory, and that their use of chaos theory amounts to an attack on science.

This section will explore science's 'counter-critique' of the literary use of chaos theory in relation to the wider debate concerning the cultural use of scientific ideas known as the 'science wars.' The 'counter-critique' encompasses both serious and satirical forms. Its serious form is characterised by Paul G. Gross' and Norman Levitt's *Higher Superstition: The Academic Left and Its Quarrels with Science* (1994),⁵⁷ *The Flight from Science and Reason* (1996), and Carl Matheson's and Evan Kirchoff's "Chaos and Literature" (1997).⁵⁸ The other form of the counter-critique is satirical, and is represented by Alan D. Sokal, a Professor of Physics at the University of New York, who satirically deconstructs the literary appropriation of scientific ideas, including chaos theory, in "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" (1996).⁵⁹

⁵⁷ Andrew Ross, editor of the cultural studies journal *Social Text*, argues that *Higher Superstition* has been instrumental in establishing the tone of the "Science Wars." See Ross, Introduction to *Social Text* 46/47, Volume 14, No. 1/2, 1996, p. 7.

⁵⁸ Gross, Levitt and Martin W. Lewis, eds, *The Flight from Science and Reason*, Annals of the New York Academy of Sciences Volume 775, New York: New York Academy of Sciences, 1996; and Carl Matheson and Evan Kirchoff, "Chaos and Literature," in *Philosophy and Literature*, Volume 21, No. 1, 1997, pp 28-45. 128.220.50.88/journals/philosophy_and_literature/v021/21.1matheson.html (20 Aug 1997).

⁵⁹ Alan D. Sokal, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity," in *Social Text* 46/47, 1996, Volume 14, No. 1/2, pp. 217-52. www.physics.nyu.edu:80/faculty/sokal/transgress_v2/transgress_v2_singlefile.html (Feb 19 1997).

In *Higher Superstition* Gross and Levitt object to the assertion made by critics “that the methods of social theory and literary analysis are equal in epistemic power to those of science.”⁶⁰ They take issue with the idea that literature possesses an equivalent epistemological potency to modern science and dispute the literary assertion that its use of chaos theory strengthens its epistemology. To Gross and Levitt, critics like Porush have made extremely contentious and unsubstantiated claims to authority through their use of chaos theory. Porush provides little evidence to support his use of chaos theory, and it is not surprising that Gross and Levitt dispute his methodology as well as his philosophy. However, in construing the literary use of chaos theory as an attack on science, Gross and Levitt fundamentally fail to understand how critics perceive chaos theory, and how it functions in the humanities. Their strategies, which are meant to dismiss literature’s use of chaos theory, instead undermine the arguments of the counter-critique against cultural interpretations of scientific knowledge.

Gross and Levitt are acutely aware that many critics have been drawn to the writings of Ilya Prigogine. They identify Prigogine as a contributor to the literary use of chaos theory, and imply that if Prigogine is suitably castigated then his reputation as a scientist will be weakened. As a result, therefore, his appeal in the humanities may also be weakened. Gross and Levitt identify Prigogine as the chaologist most favoured by critics, and comment that “his name keeps coming up in postmodern discourses with depressing frequency.”⁶¹ By describing Prigogine as a “[n]oted chemist” and by despairing at his adoption by postmodernism, Gross and Levitt indicate that they value Prigogine’s scientific achievements. Nevertheless, because of his association with the humanities, they find it necessary to discredit him by suggesting that the very fact that literary critics have adopted his ideas is indicative of his ability to transgress the intellectual confines of science.

Gross and Levitt argue that because he fails to dissociate himself from his philosophical speculations and the resulting literary interpretations of his ideas, Prigogine implicitly condones and encourages postmodernism, which is considered by many scientists as the antithesis of the methodological purity and authority of science.

⁶⁰ Gross and Levitt, *Higher Superstition*, p. 12.

⁶¹ *Ibid.*, p. 96.

Postmodernism and deconstruction are considered by many scientists to be an intellectual contaminant: Cosma Rohilla Shalizi describes them as the “French Disease.”⁶² This view is perpetuated by Gross and Levitt, who suggest that “[k]eeping the hard sciences from contamination” by postmodernism is one of their main objectives.⁶³ Given science’s poor opinion of postmodernism, the labelling of Prigogine as a ‘postmodernist sympathiser’ is a serious accusation. Prigogine’s belief that science should participate in social discourse is therefore read by Gross and Levitt as evidence that Prigogine has “slipped into habits of speculation that involve him in very shaky science and even shakier mathematics.”⁶⁴ The implication here is that speculation has no place in the practice of good science.

The usefulness of maintaining such rigid distinctions between the epistemologies and methodologies of science and the humanities is contested by the literary interpreters of chaos theory. In “Social Science as the Study of Complex Systems” (1996) David L. Harvey and Michael Reed suggest that the “dogmatic insistence that only mathematically bracketed chaos studies can qualify as valid... must be avoided. Such a stance is too narrow and risks excluding the valuable perspectives the cultural sciences and the humanities offer...”⁶⁵ Harvey and Reed note that while the protests of the scientists who oppose cultural extrapolations of chaos theory “may be technically correct, this unabridged idealism can stifle discoveries that might otherwise flow from marginal application[s] of these new ideas.”⁶⁶ Harvey and Reed concede that although each abstraction of chaos theory from its mathematically pure roots destabilises its origins, they also acknowledge that without such abstractions deterministic chaos would not have developed as it has developed.

Gross and Levitt provide a second argument designed to discredit Prigogine in the humanities. They assert that because Prigogine has not made any recent scientific discoveries, his earlier work lacks credibility: “a realistic view of Prigogine’s science would have to come to terms with the fact that serious contributions have not been

⁶² Cosma Rohilla Shalizi, “Chaos, and more generally non-linear dynamics.” www.physics.wisc.edu/~shalizi/notebooks/chaos.html (30 Jul 1996).

⁶³ Gross and Levitt, *Higher Superstition*, p. 106.

⁶⁴ *Ibid.*, p. 96.

⁶⁵ David L. Harvey and Michael Reed, “Social Science as the Study of Complex Systems,” in *Chaos Theory in the Social Sciences*, pp. 295-323, p. 323.

⁶⁶ *Ibid.*, p. 323.

forthcoming [from him] for a couple of decades.”⁶⁷ This argument is irrelevant to the significance of Prigogine’s achievements. Kuberski in *Chaosmos* offers an insightful analysis of the reasons why Prigogine’s ideas have not been well received by other scientists. He explains that:

Philosophizing scientists are sometimes regarded by other scientists as past their prime, exhausted by the demands of research and anxious to reach some personal and professional conclusions unwarranted by the evidence. There is a good deal of truth to such views, but they conceal philosophical premises of their own that, because they are widely held, appear nonexistent.⁶⁸

Kuberski acknowledges that Prigogine may produce no more startling new ideas, but at the same time he exposes the ideological premise - that science should be objective and isolated from cultural interference - that directs Gross and Levitt to distrust “generalist” and “conceptual” arguments of the type developed by Prigogine.

The problem with Gross’ and Levitt’s critique of Prigogine’s merit as a scientist is that it fails to recognise that speculative ideas may have great value: it is only when an idea is disproven that it ceases to be scientifically valid. Kuhn states in *The Structure of Scientific Revolutions* that “during pre-paradigm periods and during the crises that lead to large-scale changes of paradigm, scientists usually develop many speculative and unarticulated theories that can themselves point the way to discovery.”⁶⁹ The very meaning of ‘speculation’ suggests that the mathematical proofs for an idea do not presently exist, although they may be established in the future. The history of science demonstrates that unsubstantiated ideas sometimes require a considerable amount of time to be verified. To give an example, some of the details of Einstein’s theories of Relativity are still being tested decades after his death.⁷⁰ This does not mean that Einstein’s ideas have been considered useless speculations in the time between their

⁶⁷ Gross and Levitt, *Higher Superstition*, p. 96.

⁶⁸ Kuberski, *Chaosmos*, p. 36.

⁶⁹ Kuhn, *The Structure of Scientific Revolutions*, p. 61.

⁷⁰ See for example the work of the group led by Randall G. Hulet in the Department of Physics at Rice University at Houston, Texas. Their WWW page states that “Bose-Einstein condensation (BEC) was predicted more than 70 years ago,” but is only now (1995/6) that “the observation of BEC in atomic gases [has become] possible.” atomcool.rice.edu/papers/becprl/bec.ps (Jan 13, 1997). The group has already published one paper, “Evidence of Bose-Einstein Condensation in an Atomic Gas with Attractive Interactions,” by C. C. Bradley, C. A. Sackett, J. J. Tollett, and R. G. Hulet, in *Physical Review Letters*, Volume 75, No. 1687 (1995).

publication and eventual confirmation: on the contrary, they have been considered plausible scientific theories that could not necessarily be confirmed in the short term.⁷¹

Gross' and Levitt's denigration of Prigogine's speculative methodology is unsustainable in this context, for it does not give Prigogine sufficient time to have his ideas thoroughly considered by his peers. Nevertheless, this style of argument is widespread in the scientific response to the literary appropriation of scientific ideas. It is important to note that Gross and Levitt are however not alone in their criticism of Prigogine: they claim to represent the views of many scientists. Kuberski in *Chaosmos* acknowledges that:

the views of... Prigogine and Stengers are not, of course, widely or generously received by research scientists. Focused on the specific issues of their own research, they are suspicious of generalist proclamations and paradigm shifts. And there can be no doubt that conceptual arguments about science as a whole tend at times toward metaphysical or unverifiable claims.⁷²

Applied chaologists distrust philosophical interpretations of chaos theory and Prigogine's attempts to open the discourse of chaos theory to the humanities are therefore strongly resisted.

In "Social Science as the Study of Complex Systems" Harvey and Reed forward a second argument in favour of opening chaos theory to various interpretations. They target the narrow scientific worldview presented in *Higher Superstition* when they refer to a "minor squabble" between "chaos mathematicians and physical scientists working in the area of dissipative systems" to suggest that:

mathematicians claim, with justification, that physical scientists, as they operationalize their ideas in concrete research settings, are making a mockery of their precise formulations. In making such charges, the mathematicians hold up an abstract ideal and use it to denigrate the accomplishments and interpretations of experimental scientists.⁷³

This analysis of the physical sciences' imperfect abstraction by the 'pure' methodology of mathematics destabilises the counter-critique's derision of literary and cultural interpretations of chaos theory for it reveals a parallel between the physical sciences and

⁷¹ Beer comments in *Darwin's Plots* that "major theories tax, affront, and exhilarate those who first encounter them, although in fifty years or so they will be taken for granted..." The implication of this for chaos theory is that the new ideas it develops should be given time to be proven or disproven. Beer, *Darwin's Plots*, p. 3.

⁷² Kuberski, *Chaosmos*, p. 36.

the humanities: both apply abstract concepts developed in mathematics to physical and social systems. The accusations made against physical scientists by mathematicians are leveled against literary critics by scientists like Gross and Levitt. It is illogical for scientists to criticise cultural applications of chaos theory when their own applications of it are methodologically suspect.

Proponents of the counter-critique are not only concerned with the introduction of chaos theory into the humanities through the texts of Prigogine and other scientists: they are equally concerned with the appropriation of chaos by writers and critics who may not possess a thorough understanding of its principles. Gross and Levitt claim in *Higher Superstition* that critics fail to comprehend the principles of chaos theory and instead use “moral authority” to justify their appropriation of it.⁷⁴ They object to “essays that make knowing reference to chaos theory, from writers who could not recognize, much less solve, a first-order linear differential equation.”⁷⁵ This argument misses the point; literary and cultural critics do not wish to employ chaos theory as scientists do, but to adapt it to social and fictional circumstances. This necessitates an understanding of the principles of chaos theory: ideas which, as the popular texts of chaos theory demonstrate, can be expressed in relatively simple, non-mathematical, terms.

Gross and Levitt consider the literary ‘misinterpretation’ of chaos theory to be an attack on the discipline of science which is motivated by an intense anti-science ideology. Their anti-postmodern agenda becomes most apparent in this aspect of their critique of the literary and cultural use of chaos theory. They argue that postmodernism and deconstruction are ideologically opposed to science and logic and that the literary use of chaos theory is “hardly distinguishable from hostility.”⁷⁶ To Hayles and Porush, this argument misses the point; they consider their fascination with chaos theory to be indicative of their support for it. Nevertheless, Gross and Levitt argue from the premise that some critics have dismissed the aims and achievements of modern science that all critics must be opposed to all forms of scientific knowledge. They draw attention to the anti-science views attributed to some critics, such as feminists who critique the

⁷³ Harvey and Reed, “Social Science as the Study of Complex Systems,” p. 323.

⁷⁴ Gross and Levitt, *Higher Superstition*, p. 6.

⁷⁵ *Ibid.*, p. 6.

patriarchal agenda of medical science, and post-colonialists who discuss the environmental consequences of western science, industry, and technology, and then confuse various types of critics: queer theorists are conflated with poststructuralists, radical feminists with politically conservative postmodern philosophers, and literary theorists are compared to historians and social scientists.⁷⁷ This congregation of critics is defined and attacked as a singular opponent, although no evidence is provided to support the assertion that all these groups of critics have the same view of science.

Gross and Levitt maintain that “hostility to science is... an inextricable element of... postmodern philosophical excursions” like Hayles’ *Chaos Bound*.⁷⁸ They characterise interpretations of chaos theory as attempts to delineate science’s negative political implications, and make no concession to those critics who view science as an essential part of society:

Modern science is seen, by virtually all of its critics, to be both a powerful instrument of the reigning order and an ideological guarantor of its legitimacy. It is stained by all the sins of the culture that engenders and nurtures it. Thus, whoever attacks it with a view to vindicating the oppressed, no matter how quixotic the methods, is seen to be fighting the good fight.⁷⁹

They accuse critics of only being interested in attacking science despite their own admission that Hayles’ perception of science is “liberatory and politically progressive.”⁸⁰ By contradicting themselves Gross and Levitt represent the scientific response to the literary use of chaos theory as subjective and politically driven. Further evidence of the political nature of *Higher Superstition* is furnished by its use of derogatory terms to describe *Chaos Bound* as an “odd hypothesis,” a “bizarre thesis,”⁸¹ and a “grotesque” and “distended” “misreading of science.”⁸² These metaphors of physical deformity paint

⁷⁶ *Ibid.*, p. 100.

⁷⁷ Prigogine and Stengers summarise the views of these critics thus: “In only one hundred [and] fifty years, science has been downgraded from a source of inspiration for Western culture to a threat. Not only does it threaten man’s material existence, but also, more subtly, it threatens to destroy the traditions and experiences that are most deeply rooted in our cultural life.” See *Order out of Chaos*, pp. 30-1.

⁷⁸ Gross and Levitt, *Higher Superstition*, p. 106.

⁷⁹ *Ibid.*, p. 12.

⁸⁰ *Ibid.*, p. 100.

⁸¹ *Ibid.*, p. 99.

⁸² *Ibid.*, p. 100.

Chaos Bound as an academic aberration, and provide further confirmation that the counter-critique is inherently subjective.

Higher Superstition describes *Chaos Bound* as being full of “subjective and shoddy analogies, leaky metaphors, and... flat and unsupported assertions.”⁸³ This criticism can be just as effectively leveled against *Higher Superstition*. To give but one example of their use of unsupported assertions, Gross and Levitt describe feminist theorists like Donna Haraway as members of the “feminist-critique-of-industry mafia.”⁸⁴ What can be made of this criticism, other than that it is extremely shoddy, subjective, and unsupported?⁸⁵ Jeffrey Shallit notes in “Leftist Science and Skeptical Rhetoric” (1994) that *Higher Superstition* “is an often-sloppy polemic that indulges in some of the same tactics it decries.”⁸⁶ Arkady Plotnitsky comments in “‘But It Is Above All Not True’: Derrida, Relativity, and the ‘Science Wars’” (1997) that *Higher Superstition* contains “many accusations and complaints” but lacks in a credible, sustained attack on the cultural use of science.⁸⁷ Far from embodying an objective response to the literary interpretation of chaos theory, *Higher Superstition* merely defines a subjective scientific response to the literary use of science.

In its approach to the science wars *Higher Superstition* has been substantially influenced by Roger Kimball’s *Tenured Radicals: How Politics has Corrupted our Higher Education* (1990): a text that systematically denounces the postmodern ‘attack’ on the canon and traditions of western literature and the humanities.⁸⁸ Gross and Levitt also owe a debt to Christopher Lasch’s *The Revolt of the Elites: the Betrayal of Democracy* (1995), which similarly decries the postmodernist assault against modern sensibilities. *Higher Superstition* is a reactionary text which criticises ‘liberal’ views of

⁸³ *Ibid.*, p. 100.

⁸⁴ *Ibid.*, p. 100.

⁸⁵ *Ibid.*, p. 99.

⁸⁶ Jeffrey Shallit, “Leftist Science and Skeptical Rhetoric,” in *Skeptic*, Volume 3, No. 1, 1994, pp. 98-100. www.skeptic.com/03.1.shallit-higher.html (21 Oct 1996).

⁸⁷ Arkady Plotnitsky, “‘But It Is Above All Not True’: Derrida, Relativity, and the ‘Science Wars,’” in *Postmodern Culture*, Volume 7, No. 2, 1997, calliope.jhu.edu/journals/pmc/v007/7.2plotnitsky.html (20 Jun 1997).

⁸⁸ Roger Kimball, *Tenured Radicals: How Politics has Corrupted our Higher Education*, New York: Harper and Row, 1990.

science, education, and politics from an explicitly anti-postmodern perspective.⁸⁹ Its agenda is not to examine how literature manipulates scientific concepts but to discredit postmodernism for questioning and destabilising the methodologies of modernity as they relate to science.⁹⁰ The methodology adopted by the counter-critique, therefore, is not designed to enact a thorough critique of literature's representative strategies but to denigrate these strategies regardless of their characteristics.

The counter-critique perceives that serious critical discourse is not necessarily the most effective means for undermining literary texts, and that alternative forms of discourse may further empower its opposition to literature's use of chaos theory. In this context it is interesting to note that Levitt comments in "Mathematics as the Stepchild of Contemporary Culture" (1996) that "it will take considerable ingenuity, perhaps on the part of a practical joker of genius, to shake" the hold literary critics presently have on chaos theory.⁹¹ *The Flight from Science and Reason* makes no mention of Alan D. Sokal, yet in this statement Levitt pre-empts Sokal's parody of literary interpretations of science in "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity." Perhaps because much of the counter-critique has failed to come to terms with the literary appropriation of chaos theory in a serious critical manner, Sokal explains in "A Physicist Experiments With Cultural Studies" (1996) that he considers satire to be "by far the best weapon" for criticising literary interpretations of science.⁹²

The subject of "Transgressing the Boundaries" is not particularly important - it forwards an argument which suggests that quantum mechanics, relativity, and other scientific ideas, particularly the concept of quantum gravity, have significant cultural implications - what is important about it is the way it mimics and parodies texts like Hayles' *Chaos Bound*. Soon after its publication in *Social Text*, Sokal announced in "A Physicist Experiments With Cultural Studies" (1996) in *Lingua Franca* that

⁸⁹ Christopher Lasch, *The Revolt of the Elites: the Betrayal of Democracy*, New York: W. W. Norton, 1995.

⁹⁰ One of the best critiques of the rhetoric of *Higher Superstition* is Brian Martin's "Social Construction of an 'Attack on Science,'" in *Social Studies of Science*, Volume 26, No. 1, February 1996, pp. 161-73. www.uow.edu.au/arts/sts/bmartin/pubs/96sss1.html (6 Feb 1998).

⁹¹ Levitt, "Mathematics as the Stepchild of Contemporary Culture," in *The Flight from Science and Reason*, pp. 39-53, p. 50.

⁹² Sokal, "A Physicist Experiments With Cultural Studies," in *Lingua Franca*, May/June 1996, pp. 62-4. www.physics.nyu.edu:80/faculty/sokal/lingua_franca_v4/lingua_franca_v4.html (19 Feb 1997).

“Transgressing the Boundaries” was a hoax designed to parody postmodern appropriations of scientific ideas. “Transgressing the Boundaries” and his subsequent papers concerning the science wars establish Sokal’s argument that literary applications of scientific ideas are so logically flawed that they achieve nothing, and are so implausible that they should not be disregarded. The strategies employed by Sokal include the liberal use of scientific metaphors and the application of these metaphors to social systems. He mimics these literary processes to reveal the logical gaps and leaps of faith made in the transvaluation of chaos theory, and also argues that the implausibility of literary appropriations of science are actually harming the cause of the political left in the context of American academe.

Sokal argues in “Transgressing the Boundaries: An Afterword” (1996) that “[l]ike the genre it is meant to satirize - myriad exemplars of which can be found in my reference list - my article is a *mélange* of truths, half-truths, quarter-truths, falsehoods, non sequiturs, and syntactically correct sentences that have no meaning whatsoever.”⁹³ He argues that the literary interpretation of chaos theory is based on “speculative theories passed off as established science; strained and even absurd analogies; rhetoric that sounds good but whose meaning is ambiguous; and confusion between the technical and everyday senses of English words.”⁹⁴ The problem with this, argues Sokal, is that “verbal game-playing displaces the rigorous analysis of social realities” and destabilises the literary use of science: by engaging in this discursive play, postmodern literature undermines its ability to engage with the discourse of science.⁹⁵

Sokal and Jean Bricmont draw attention to the critics they consider most responsible for this misappropriation in “What is the fuss all about?” (1997), arguing that:

famous intellectuals such as Jacques Lacan, Julia Kristeva, Luce Irigaray, Jean Baudrillard and Gilles Deleuze have repeatedly abused scientific concepts and terminology: either using scientific ideas totally out of context, without giving the slightest empirical or conceptual justification - note that we are not against extrapolating concepts from one

⁹³ Sokal, “Transgressing the Boundaries: An Afterword,” in *Dissent*, Volume 43, No. 4, 1996, pp. 93-9. www.physics.nyu.edu:80/faculty/sokal/afterword_v1a/afterword_v1a_singlefile.html (19 Feb 1997), and *Philosophy and Literature*, Volume 20, No. 2, 1996, pp. 338-46. 128.220.50.88/journals/philosophy_and_literature/v020/20.2sokal.html (20 Aug 1997).

⁹⁴ Sokal, “A Physicist Experiments With Cultural Studies.”

⁹⁵ Sokal, “Transgressing the Boundaries: An Afterword.”

field to another, but only against extrapolations made without argument - or throwing around scientific jargon to their non-scientist readers without any regard for its relevance or even its meaning.⁹⁶

In “Transgressing the Boundaries: An Afterword” Sokal quotes Larry Laudan, who argues in *Science and Relativism* (1990) that:

My... target is those contemporaries who - in repeated acts of wish-fulfillment - have appropriated conclusions from the philosophy of science and put them to work in aid of a variety of social cum political causes for which those conclusions are ill adapted. Feminists, religious apologists (including ‘creation scientists’), counterculturalists, neoconservatives, and a host of other curious fellow-travelers have claimed to find crucial grist for their mills in, for instance, the avowed incommensurability and underdetermination of scientific theories.⁹⁷

Like Gross and Levitt, Sokal maintains that these loosely-defined ‘postmodernists’ hold exactly the same views in relation to science, although he does not even attempt to demonstrate that this is the case.

The “postmodernist silliness” of the literary use of chaos theory is to Sokal a threat to science’s notion of an objective, external reality. At the core of the science wars is a distinction between science and the humanities concerning the fundamental nature of reality and the ability of individuals to observe and understand reality, whether this can be achieved objectively or subjectively, and whether claims about truth can reliably be made. The “epistemic relativism” of postmodernism is discussed by Bricmont and Sokal in “What is the fuss all about?”⁹⁸ Sokal argues in “A Plea for Reason, Evidence and Logic” (1997) that the science wars are not so much concerned with “the social role of science and technology” or disciplinary differences as with “the nature of truth, reason and objectivity.”⁹⁹ He claims in “Transgressing the Boundaries” that his aim was not “to defend science from the barbarian hordes of lit crit or sociology” but to “defend what one might call a scientific worldview - defined broadly as a respect for evidence and logic, and for the incessant confrontation of theories with the real world.”¹⁰⁰ Sokal’s aim

⁹⁶ Jean Bricmont and Alan Sokal, “What is the fuss all about?” *Times Literary Supplement*, 17 October 1997, p. 17. www.physics.nyu.edu/faculty/sokal/tls.html (14 Jan 1998).

⁹⁷ Larry Laudan, quoted in Sokal, “Transgressing the Boundaries: An Afterword.” See Larry Laudan, *Science and Relativism*, Chicago: University of Chicago Press, 1990, p. x.

⁹⁸ Bricmont and Sokal, “What is the fuss all about?”

⁹⁹ Sokal, “A Plea for Reason, Evidence and Logic,” in *New Politics*, Volume 6, No. 2, 1997, pp. 126-9. www.physics.nyu.edu/faculty/sokal/nyu_forum.html (6 Oct 1997).

¹⁰⁰ Sokal, “Transgressing the Boundaries.”

is to uphold the legitimacy of modern science's preoccupation with truth and objectivity in the face of postmodernism relativity and ambiguity.

The literary use of chaos theory is at odds with the discourse of modern science because it exists for reasons extraneous to proving or disproving scientific theories. To Sokal, it defines a kind of neo-fictional pseudo-theory which contain ideas, as fictional texts do, but no real meaning. Literature's use of chaos theory can be described as neo-fictional because it defines the principles of chaos theory within fiction, and suggests that the 'real world' studied by science can be represented or modelled in fictional texts. Literature's use of chaos theory confuses scientists because it is so different from its use in science, but this does not diminish the validity of its interest in chaos theory. Sokal also argues that the literary use of chaos theory represents a threat to the values of Leftist politics to which Sokal overtly declares his allegiance.¹⁰¹ In "Professor Latour's Philosophical Mystifications" (1997) he states that "I wrote my parody not to defend science against the supposed barbarian hordes of sociology, but to defend the American academic left against irrationalist tendencies which, though fashionable, are nevertheless suicidal."¹⁰² It is difficult to defend this argument because the political machinations of American academe form only a fragment of the substance of the science wars and of postmodern literature. Sokal claims that it is his goal to defend the American academic left from being undermined from within by postmodern appropriations of scientific ideas. The plausibility of this argument is strained, however: Sokal is a scientist and therefore he is not primarily responsible for the behaviour of humanities scholars whom, although prominent in the American academic left, cannot be said to dominate it. This argument detracts from the primary issue at hand: the literary use of chaos theory.

Considerable comment ensued about Sokal's hoax.¹⁰³ In "Science, Fiction and the Appeal of Complexity" (c 1995) An Vranckx argues that:

¹⁰¹ Sokal, "Transgressing the Boundaries: An Afterword."

¹⁰² Sokal, "Professor Latour's Philosophical Mystifications."

www.physics.nyu.edu:80/faculty/sokal/le_monde_english.html (19 Feb 1997) (Trans. of "Why I wrote my parody," in *Le Monde*, 31 January 1997).

¹⁰³ A number of webpages are devoted to the topic. See Sokal's own homepage at www.physics.nyu.edu/faculty/sokal.html (6 Oct 1997); Jason Walsh's 'Sokal Affair' page at weber.u.washington.edu/%7Ejwalsh/sokal/ (30 Jul 1996), which has subsequently changed to www.blarg.net/~jwalsh/sokal/ (6 Oct 1997); and Gen Kuroki's 'The Sokal Affair - A Physicist vs Postmodern Cultural Analysts' page at www.math.tohoku.ac.jp/~kuroki/Sokal/ (6 Oct 1997).

Concerns over extra-scientific abuse of the complex adaptive system have been well-published lately. Such commotion over semantic distortion of scientific concepts appears ill-founded in at least one respect. Its reasoning demarcates scholarly activity against disturbingly unspecified 'extra-scientific' realms, and seldomly refers to empirical studies on science and policy. Coarse notions of common sense are invoked instead, that fail to elucidate how science may differ from or correspond with articulation practices in other domains of human activity.¹⁰⁴

Vranckx implies that the counter-critique fails to properly address the implications of literary and cultural uses of scientific ideas because it does not adequately consider literary and cultural practices. Instead, scientists attack what they perceive to be a threat to science, and refuse to accept that critics offer no threat to science at all. Vranckx suggests that Sokal's inability to recognise the discursive differences between science and the humanities indicates that he has failed to come to terms with the literary use of chaos theory.

In "Pomolotov Cocktail" (1996) Katha Pollitt addresses another of the political context of the literary use of chaos theory. She argues that Sokal's assertion that postmodernism is essentially tied to 'leftist' values and ideologies in the context of American politics is the "biggest misconception" of his argument and is unfounded.¹⁰⁵ Gross and Levitt suggest in *Higher Superstition* that postmodernism is intrinsically oriented towards the left. The issue of the political implications of the literary use of chaos theory is complicated by Sokal's assertion that he is a leftist, and that critics like Donna Haraway and Andrew Ross are subverting the left through their undisciplined appropriation of scientific ideas. Sokal provides no evidence to substantiate these claims, and relies instead on assumptions about the nature of postmodernism and its relationship with leftist politics to discourage the application chaos theory to political systems. Although connections can be drawn between postmodern theory and leftist politics, and between the theoretical and political views of critics and the subjects that interest them, these connections are not predominant in the literary use of chaos theory and are not explored in any depth by Gross and Levitt or Sokal. The association of postmodernism with leftist politics therefore fails to undermine literary interpretations of chaos theory

¹⁰⁴ An Vranckx, "Science, Fiction and the Appeal of Complexity." pespmc1.vub.ac.be/CLEA/Reports/Scificompl.html (14 Jan 1997).

¹⁰⁵ Katha Pollitt, "Pomolotov Cocktail," in *The Nation*, 10 June 1996. www.thenation.com/issue/960610/0610poll.htm (19 Feb 1997).

because it does not indicate how political associations negatively impact on literature's ability to interpret scientific ideas.

The subjectivity of the counter-critique is established by the parodic nature of Sokal's "Transgressing the Boundaries." Robert Phiddian argues in "Are Parody and Deconstruction Secretly the Same Thing?" (1997) that "[l]iterary hoaxes and causes célèbres show that parodic language is language in play."¹⁰⁶ Phiddian's objective is to show that "deconstruction does not aspire in a straightforward way to be a discourse of truth. It is interested in questions of truth, but it does not pursue them in [a] direct, serious, and analytic fashion."¹⁰⁷ His argument that "parodic language is language in play" is important, for it suggests that in using parody to critique the literary use of chaos theory Sokal adopts the style of discourse that he claims to oppose. Phiddian argues that:

the comic aspects of parody do generate critical perspectives. These are not the objective critical perspective desired by straw-Plato metaphysics (the sort of dumbly serious logic that deconstruction loves to torment); rather they tend to be an unstable array of critical perspectives dependent on reader competence and response. Through these filters, language connects with both expression and mimesis, always ironically and never entirely earnestly. Political implications may (usually will) follow from this...¹⁰⁸

Parody achieves its critical purpose in a non-objective manner that depends to a significant extent on the response of the reader, who filters the political implications of parodic ideas according to their own impressions of their critical and comic value. When this is considered in relation to Sokal's parody, it is apparent that he achieves his purpose in a subjective manner which has clear political implications: he does not provide a rational or objective analysis of literature's use of chaos theory but satirically interprets it in a manner that essentially relies on playful literary practices to achieve its effect.

There are three reasons therefore why the counter-critique has thus far failed to discourage literary interpretations of chaos theory. Firstly, it is only in the early stages of its development, and while significant texts like Sokal's "Transgressing the Boundaries" have emerged, the scientific response to literature's interest in chaos theory has not yet

¹⁰⁶ Robert Phiddian, "Are Parody and Deconstruction Secretly the Same Thing?" in *New Literary History*, Volume 28, No. 4, 1997, pp. 673-696, p. 682.
muse.jhu.edu/journals/new_literary_history/v028/28.4phiddian.html (19 Jan 1998).

¹⁰⁷ *Ibid.*, p. 673.

¹⁰⁸ *Ibid.*, p. 691.

properly found its voice.¹⁰⁹ The main protagonists have, however, become conspicuous: Gross and Levitt and Sokal have initiated much of the counter-critique and are its most vocal contributors. Secondly, the counter-critique has not chosen its targets wisely: it does not focus on the most contentious or significant examples of the literary use of chaos theory, and subsequently fails to impact upon the most influential literary texts. Gross and Levitt claim to examine the worst excesses of literature's interest in science, but they really focus on its least contentious examples. For example, they demonise Hayles' *Chaos Bound* but ignore Baudrillard's texts, which offers a far more contentious interpretation of chaos theory than *Chaos Bound*.

Moreover, one of the most problematical aspects of the literary use of chaos theory - the assertion that chaos theory is not only a postmodern science, but that it is the science of postmodernity - is not thoroughly discussed in *Higher Superstition*. This discursive and epistemological shift is significant to literary critics, for it suggests that the respective epistemological strengths of science and the humanities are not only equivalent but inter-changeable, yet it is also an unfounded assertion that cannot be affirmed in any objective sense. Further evidence of the counter-critique's inability to distinguish significant from obscure literary interpretations of chaos theory is provided by Mario Bunge, who refers to only two obscure cultural uses of chaos theory in "In Praise of Intolerance to Charlatanism in Academia" (1996) to argue that all such uses are invalid. Bunge argues that because the 'politologists' James N. Rosenau and Courtney Brown do not use mathematical equations to prove their arguments their applications of chaos theory to social systems are "pseudo-scientific" and without substance.¹¹⁰ Bunge's argument lacks foundation for, as the scientist authors of popular chaos theory texts

¹⁰⁹ New texts continue to emerge. See for example: Sokal, "A Plea for Reason, Evidence and Logic," in *New Politics*, Volume 6, No. 2, 1997, pp. 126-9. www.physics.nyu.edu/faculty/sokal/nyu_forum.html (6 Oct 1997); Jon-K Adams, "Ad Scientiam: The Appeal to Science." www.math.tohoku.ac.jp/~kuroki/Sokal/adams.html (6 Oct 1997); and Noretta Koertge, ed., *A House Built on Sand: Flaws in the Cultural Studies Account of Science*, Oxford: Oxford University Press, 1997.

¹¹⁰ Mario Bunge, "In Praise of Intolerance to Charlatanism in Academia," in *The Flight from Science and Reason*, pp. 96-115, p. 104. See Courtney Brown, "Politics and the Environment: Nonlinear Instabilities Dominate," in *American Political Science Review*, Volume 88, 1994, pp. 292-303; and James N. Rosenau, *Turbulence in World Politics: A Theory of Change and Continuity*, Princeton: Princeton University Press, 1990.

have demonstrated, it is not essential to use equations to explain chaos theory - metaphors provide a far better tool for the explication of chaos theory.

The counter-critique's third deficiency has been its inability to characterise literary interpretations of scientific ideas as gross or deliberate misrepresentations. An example of this fallacious argument is expounded by Jean Bricmont in "Science of Chaos or Chaos in Science" (1996).¹¹¹ Although he notes that "Prigogine and Stengers are not responsible" for the (mis)interpretations of chaos theory advanced by these theorists, Bricmont fails to actually offer a critical commentary of the texts he quotes - he implies that they contain the exegesis of their own illogicality, and therefore that he is not required to examine their deficient arguments. Gross, Levitt, and Sokal argue that literature distorts and misrepresents scientific ideas, and that only the supposedly transparent, objective language of science can accurately and legitimately employ the discourse of chaos theory. Critics respond with the argument that science's real use of language is quite different to perception of its use, and suggest that some scientists acknowledge that language is not a transparent tool but a far more complex system.

SUMMARY

Bono's assertion that literary theory is able to examine the narrative strategies at work in scientific discourses has been affirmed by the critics who elucidate the political subtexts of the popular texts of chaos theory and the counter-critique.¹¹² In the process of delineating the significance of chaos theory for literature Hayles and Porush have discovered that modern science is more concerned with protecting its authority than it is in discussing the epistemological or philosophical implications of chaos theory. The strident tone of the counter-critique is indicative of the umbrage of those who claim to speak for science at literature's encroachment into their discursive territory, but they have thus far failed to deter further literary interest in chaos theory. Indeed, science's response to literature's use of chaos theory may paradoxically promote further literary

¹¹¹ Bricmont, "Science of Chaos or Chaos in Science," in *The Flight from Science and Reason*, pp. 131-75, pp. 149-50.

¹¹² Locke, summarising Bono, in *Science as Writing*, pp. 206-7.

appropriations of scientific ideas. Beer comments in *Darwin's Plots* that “[t]he shape and implications of powerful ideas often become fully discernible only when a reaction against them has set in.”¹¹³ The extent of science’s response to the literary use of chaos theory suggests that it is an important development in contemporary literature.

The counter-critique has yet to successfully defend science’s ownership of chaos theory because its seminal arguments are flawed. Gross’ and Levitt’s use of subjective language to describe critics like Donna Haraway distorts the tone of their supposedly ‘scientific’ critique, and does not adequately support their claim that science’s epistemology is superior to that of literature.¹¹⁴ The political agenda of *Higher Superstition* - its didactic aversion to postmodernism - conflicts with its purpose: to accurately and objectively examine the deficiencies in literature’s use of scientific ideas. *Higher Superstition* fails to reassert scientific control of the discourse of chaos theory because it is no more an objective, scientific text than the texts it condemns. Evans M. Harrell, who supports science’s perspective in the science wars, admits in “A report from the front of the ‘Science Wars’” (1996) that “the enemies of science cannot simply be dismissed as fools... and indeed they are disturbingly like ourselves in many ways.”¹¹⁵ Sokal aims to draw attention to subjective misinterpretations of science, yet he cannot achieve this without indulging in the same sort of intertextual games favoured by Baudrillard and other literary critics. The counter-critique will not succeed until it is able to succinctly differentiate itself from the discourse and strategies of the literary texts it examines.

The debate within chaos theory, and the subsequent dispute between science and the humanities concerning the comparative epistemological strengths of chaos theory and literature, should therefore not be considered the simple product of epistemological and philosophical differences, but of questionable intellectual property altercations, academic politics, and doubts about the cultural relevance of scientific ideas. Gross and Levitt

¹¹³ Beer, *Darwin's Plots*, p. 16.

¹¹⁴ Shallit notes in “Leftist Science and Skeptical Rhetoric” that Gross and Levitt adopt some extremely dubious sources to discredit the postmodern appropriation of chaos theory, including conspiracy-theory type articles “published by followers of political extremist Lyndon LaRouche.”

¹¹⁵ Evans M. Harrell, “A Report from the Front of the ‘Science Wars’: the controversy over the book *Higher Superstition*, by Gross and Levitt and the recent articles by Sokal,” *Notices of the American Mathematical Society*, October 1996. www.math.gatech.edu/%7Eharrell/cult.html or

question the assumption that a literary epistemology, even one informed by chaos theory, can be comparable to the rigorous ‘objectivity’ of modern science but their arguments reveal what many postmodernists assert: that scientists are themselves more ideological than scientific. The foundations of the controversy surrounding the literary use of chaos theory are politically parochial, rather than epistemological: conservative scientists are indignant that their more progressive peers have abandoned science’s self-imposed ideology of isolation to explore similarities between chaos theory and cultural values, and to enter into discourse with literary critics.

At the heart of the philosophical divisions within chaos theory is the issue of who is able to define the history of chaos theory and who is able to employ its discourse. The task of writing the history of chaos theory has been undertaken mainly by American applied chaologists, who have consequently elaborated the significance of their own work to the exclusion of the work of others, specifically those that offer an alternative perception of the purpose and style of chaos theory. This not a radical observation, but it does indicate that the style of applied chaos theory does not suit the needs of its literary interpreters. It is because of these stylistic differences that literature has based much of its interpretation of chaos theory on those texts that exemplify its philosophical side. In *Chaos Bound* Hayles supports Porush’s assessment of the political treatment of Prigogine by the applied branch of chaos theory and simply comments that “this remarkable omission testifies to how contested the name of chaos is, even within the physical sciences.”¹¹⁶

The contest within science for recognition and authority is immense. Mainstream scientists explicitly connect Prigogine to postmodernism and its playful discursive practices and do not even refer to him as a scientist: in *The Flight From Science and Reason* he is described as a “thinker.”¹¹⁷ Matheson and Kirchhoff argue in “Chaos and Literature” that “the connection between Prigogine and chaos theory proper is an artifact

www.ams.org/publications/notices/199610/comm-harrell.html (3 Sept 1997).

¹¹⁶ Hayles, *Chaos Bound*, p. 11.

¹¹⁷ *The Flight From Science and Reason*, edited by Gross, Levitt, and Lewis, p.117 (Note: this passage is contained in an uncredited introduction of a section of the book, and must therefore be attributed to the editors).

of a bad pun concerning the word ‘disorder.’”¹¹⁸ Further evidence of the attitude held by many prominent chaologists towards Prigogine is presented by Per Bak, who suggests that Prigogine uses “eminent intuition” to study the natural world rather than proper scientific means, and that he does not produce science but “pseudoscience.”¹¹⁹ Hayles argues that Prigogine’s “uneven” reputation within science should not negatively impact on the value of his “metaphysical speculation.”¹²⁰ This is an extremely pertinent observation, for it indicates that what science considers valuable about chaos theory is not necessarily what the humanities consider important about it. Literature’s defence of Prigogine is typical of its approach to chaos theory, which stresses speculative ideas over adherence to established methodological practices. What is most significant about the literary use of chaos theory is that it explores as fully as possible the “tantalizing metaphors” of chaos theory.¹²¹

¹¹⁸ Matheson and Kirchoff, “Chaos and Literature,” p. 32.

¹¹⁹ Per Bak, “Challenging the Timelord,” a review of *The End of Certainty: Time, Chaos, and the New Laws of Nature* by Ilya Prigogine and Isabelle Stengers, *New Scientist*, 6 September 1997. www.science-books.com/sciencebooks/reviews/endofcertainty.html (18 Feb 1998).

¹²⁰ Hayles, *Chaos Bound*, p. 112.

¹²¹ Porush, “Literature as Dissipative Structure,” p. 296.