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The Employment of Chaos: Instability and Narrative Order

Kenneth J. Knoespel

A recent cartoon portrays postmodernism as a carnival arcade barely contained by the conventional frame of the cartoon image. As caricatures of Foucault, Kristeva, and Bloom hawk their wares, workers with helmets labeled "deconstructors" break through the inky margins with jackhammers. With slight adjustment we can imagine a similar scene in which the mathematical practitioners of chaos theory open margins not with the linguistic gear of the deconstructionist but with iterative equations plotted on color monitors. The conflation of such images should not surprise us, for each has come to appear as a theoretical seismometer registering inconsistencies in systems whose logical integrity previously went unquestioned. Today even the casual observer of academic frontiers registers a shift from an unquestioned faith in the consistency of metaphysical systems and mathematical logic to a hypercritical expectation that perturbations may be detected in all systems of thought. Where critical inquiry previously assumed stability, it now explores instability and confronts complexity previously ignored or simply unseen. Whether we turn to deconstruction in philosophy or chaos theory in mathematics, we discover strategies that challenge the profession of grand logical systems to explore procedures which we may think of as experimental. The comparison of such widely divergent disciplines as literary theory and applied mathematics—amplely indicated by essays in this book—also follows from our renewed interest in the methodological commensurability of disciplines that have long appeared separated. As Jerome Bruner has noticed, we live in a world where we no longer need to fix on the objects that distinguish different fields of inquiry but where we may identify the processes of understanding that bring us together.

The study of narrative is one way for approaching the epistemological framework behind different disciplines. Narrative theory has challenged literary critics to recognize not only the various strategies used to configure particular texts within the literary canon, but to realize how forms of discourse in the natural and human sciences are themselves ordered as narratives. In effect narrative theory invites us to think of all discourse as taking the form of a story. From such a vantage point, we virtually negotiate our way through life by telling stories that explain who we are and what we are doing, and by having these stories graced onto the stories told by others. For theoreticians, the examination of such narrative networks offers a means for detecting how individuals and disciplines account for themselves, as well as how entire periods have become framed through metanarratives. From Northrop Frye's archetypes to Fredric Jameson's political unconscious, from Hayden White's historical tropes to Michel Foucault's epochal episteme, theoreticians have become accustomed to the formation and application of overarching narratives that function within critical discourse as framing devices.

The reception of Thomas Kuhn's *Structure of Scientific Revolutions* shows how attractive such metanarratives are for describing the sciences as well. But here we must be careful. While a narrative matrix certainly draws the sciences and the humanities together, it does not necessarily function on the level of the metanarrative. The cognitively fragmented world in which we live may provoke longings for metanarratives that, nevertheless, turn out to give only illusions of mending our fragmentation. Today theorists subvert metatheories one moment and erect new ones the next. While Jean-François Lyotard defines postmodernism through the dissolution of overarching metanarratives, Jameson saves them through internalization. What was once systematic metaphysical order has shifted to a psychological order that may be drawn out through the study of ideology. And even the theory of a discourse of fragmentation becomes itself an overarching narrative. The neo-Kantian formulation of spatial-temporal *transcendence*, once used to affirm the complementarity of the natural order and human science, has been replaced by a new form of transcendence in the synthetic visions offered by metanarrative.

While such universalizing strategies promote far-reaching inquiry, they also simplify the ways that meaning is negotiated within different disciplines. Katherine Hayles deserves much credit for reorienting the approach to interdisciplinary studies by challenging "impact" studies that would register the influence of science on literature. But by replacing the horizontal "impact" model with another that assumes the presence of an underlying cultural model, she anticipates a totalizing vision
that obscures the importance of her local examples. We may use the matrix of information theory to compare Mitchell Feigenbaum and Jacques Derrida without transforming information theory into a meta-narrative that reveals “underlying forces at work within culture.” Hayles does not need to authorize her valuable inquiry by lending transcendent validation to information theory.

Caution is necessary in another quarter as well. Chaos theory and deconstruction have such radically different institutional implications that it can be misleading to emphasize their complementarity. While deconstruction subverts efforts to make itself into a universal system, chaos theory—as the term itself suggests—is expectantly regarded as a basis for a new foundational synthesis. Deconstruction challenges the impulse to build an overarching system found in the very inclination to view chaos theory as the entrance to a new scientific orientation. The difference should be stressed, for it calls into question efforts to exaggerate the affinity of the two approaches. Rather than stressing an all-inclusive metatheoretical position, I want to consider how local narratives render stable the destabilizing methods made available by deconstruction and chaos theory. At a time when much inquiry draws attention to the big picture, I want to look at the little pictures. The employment of chaos arises less from universal expectations than from the demonstration of its applicability to a range of local problems.

In this essay I limit the narrative grounds for comparing chaos theory and deconstruction. Rather than pursuing the impulse to metamnarrative, I redirect attention to local narratives that are the subjects of the investigations of chaos theory and deconstruction and bring stability to their destabilizing inquiry. My discussion has three parts. In the first I notice how the very methods used to explore instability in chaos theory and deconstruction formulate a rhetoric of stability by appealing to other notational systems. Each critical enterprise, whether situated in ordinary language or in mathematical notation, engages a form of metaphorical employment that works to legitimate the enterprise. Each notational system maps itself with reference to the other. While chaos theory legitimizes itself through logocentric arguments, deconstruction delineates itself through an appeal to a “geocentric” or “mathocentric” vocabulary.

In the second part, I open a discussion of local employment by noticing how enunciens or examples map discourse within each discipline. In the third I look at the play of examples in chaos theory and deconstruction and argue that they generate both stability and instability. No matter how universal the profession of instability becomes, it remains accompanied by stabilizing narratives which appear whenever the decentering modes are applied. In the simplest sense, logical instability remains stabilized through local narrative.

I. From Plot to Emploiment

In the conclusion to his book Science in Action, Bruno Latour compares scientific discourse to a process of continuous mapping. Whether the scientist maps the earth’s surface, microorganisms within its geological structure, or the gaseous clouds of a supernova, the process involves the ongoing inscription of information. Latour’s comparison presents scientific discourse as a process generating a vast collection of narrative overlairs in which each inscription has a bearing for what comes before and after it. The comparison works so well because it draws upon the kind of conceptualizing metaphors that Lakoff and Johnson have shown are sequested deeply in our linguistic experience. We may pursue the idea of metaphoric mapping even further by following the ways deconstruction and chaos theory map themselves. A single word opens a configuration that shows how mathematical and linguistic systems authorize themselves in reference to each other. The passport that takes us into such a conceptual network is the Anglo-Saxon word “plot.”

The English word “plot” places an array of disciplinary interests before us, including Aristotle’s Poetics, the navigator finding a location in the middle of water or stars, a mathematical practitioner mapping an equation with Cartesian coordinates, not to forget the space in which Farmer McGregor plants his cabbages. Of course, plot also bears an idea of intrigue often associated with figures like Guy Fawkes or Lee Harvey Oswald. Etymologically, “plot” derives from the Latin platus and the Greek platus, both designating a flat or plane surface. The earliest use of plot and its related form plot designates a small patch set off from surrounding ground or terrain. Its use as a noun for a particular place or ground explains its subsequent use as a verb for marking or measuring a piece of land and accounts for its more specialized extension into map-making and assimilation into geometry. In its more technical sense, “plot” signifies the location of a point by means of coordinates on a map or within a geometric configuration. “Plot” appears for the first time as a plan or sketch for writing in the sixteenth century. “Plot” comes to engage an even more complex tradition of discourse when it is used to translate the Latin word fabula, itself used to render the Greek words logos and mythos. I have emphasized the metaphoric connections
of plot because it offers grounds for looking at how chaos theory and deconstruction have mapped their own inquiries.

A simple way to describe chaos theory is in regard to plotting points within a system of coordinates. Where previous studies of the curves generated by nonlinear equations suspended their work when patterns seemed to disappear and randomness took over, chaos theory discovered highly complex fluctuations. Mitchell Feigenbaum has suggested that we may even think of chaos theory as part of an evolving analysis of trajectories that began with Niccolò Tartaglia and Galileo. The mapping of the flight of cannon balls is related to the study of aperiodic trajectories generated by nonlinear equations for the simple reason that both appear as inscriptions within a system of coordinates. The difference between plotting the trajectory of cannon balls and the bifurcating trajectories in chaos theory is a radical difference in complexity. Using coordinate systems of greater complexity than the classical Cartesian grid, chaos theory makes visible as patterns numerical data previously regarded as random or inconsequential “noise.” It is not, however, numerical plotting that I would emphasize but the kind of linguistic plotting or employment provoked by the mathematical activity.

In addition to engendering a new way of plotting trajectories, chaos theory generates metanarratives to describe its implications. In their recent book Order Out of Chaos, Ilya Prigogine and Isabelle Stengers emphasize that the study of disordered systems has already allowed such articulate explanation of natural phenomena that it has been compared to the formulation of Heisenberg’s uncertainty principle (9, 216–32).4 While their declarations draw attention to the new field—as does the Foreword by Alvin Toffler—they also misrepresent it. Just as quantum mechanics does not offer scientific justification for the elaboration of a transdisciplinary view of relativism, so chaos theory does not authorize a promiscuous expectation of chaos arising from a transcendent idea of disorder. Contrary to its popularized versions, chaos theory has not constituted a metamathematical shift. What chaos theory and the uncertainty principle share more than anything else is the sophisticated extension of mathematics within carefully controlled parameters. While popular presentations of chaos theory allude to its foundational aura, the work undertaken within the field does not pertain to metaphysical speculation on primordial origins and cannot be equated with a prophecy of universal disorder. When applied to cosmology, chaos theory is experimental and hardly validates metaphysical theory (Gundig et al.). Aware of the term’s ambiguity, some mathematicians have added the seemingly contradictory adjective “deterministic” to chaos

theory to indicate its limited function. In fact, Prigogine and Mandelbrot avoid using “chaos” in their professional publications. At present it is best to think of chaos theory as an ongoing articulation of mathematical theory. As one scientist says, we should consider chaos as a kind of order without periodicity. Within generally chaotic regimes one can discover patterns of ordered motion interspersed with chaos at smaller scales, provided sufficiently high resolving power is reached in numerical or laboratory experiments. Instead of the usual spatial or temporal periodicity, there appears some kind of scale invariance which opens the possibility for renormalizing group considerations in studying chaotic transitions. (Bai-Lin 5)

The experimental orientation of chaos theory reminds us that such inquiry is separated from the analytical or theorem-proof orientation of traditional mathematics. Even when applied to cosmology, chaos theory may be thought of as justifying itself through application.

The very use of “chaos theory” to denote mathematical research concerned with the analysis of fluctuations in reiterating non-linear equations marks an intriguing example of the mythification of scientific work. By labeling such work as chaos theory, investigation is placed against the mythic background of early Greek philosophy, where chaos functions as a foundational concept in cosmology. 11 In effect, such labeling places chaos theory within the context of metaphysics and hints that it will uncover as yet hidden origins. Never mind that the term was playfully introduced into mathematics in 1968 (and earlier in the nineteenth century by Ludwig Boltzmann in the context of thermodynamics) and that most scientists would deny such a metaphysical association. The term remains and continues to be perpetuated by the very books and articles written to clarify the research. James Gleick’s recent best-seller is a case in point. At the same time that Gleick provides an intelligent survey of the new science, he validates it by situating it in the received traditions of the culture. Moving from one chapter to the next, the reader encounters a gallery of quotations from literature (John Updike, Stephen Spender, Wallace Stevens, Marlowe, Conrad Aiken, Herman Melville) that legitimate the wonders of the new science through canonical expressions of Anglo-American culture. Such decorous comparisons are not restricted to popular discussions. The introduction to a recent scientific publication on chaos includes an excerpt from Ovid’s description of the cosmos (probably indebted to Lucretius) in the Metamorphoses: “Before the ocean was, or earth, or heaven, / Nature was all alike, a shapelessness, / Chaos, so-called, all rude and lumpy matter, / Nothing but bulk, inert, in whose confusion / Discordant atoms warred”
A collection of seminal papers on chaos theory prepared in Beijing is prefaced by the simple declaration: "The Emperor of China was called Hsun-Tsun (Chaos)" (I-y-Lin, title page). At my home institution I have listened to the physicist Joe Ford initiate a faculty lecture on chaos theory with a reading from Genesis.

At a time when chaos theory and deconstruction are approached as sister projects at national conferences, there is more than a bit of irony in underscoring how the Derridean enterprise would respond to the metaphysical setting provided for chaos theory. Having challenged literary theorists and philosophers to recognize the ways their own discourse is bounded by metaphysical assumptions inherent in language, deconstruction is also able to detect the logocentric assumptions present in science. For Derrida, the ceremonial narratives used to frame chaos theory would exemplify the way mathematics has been used to "complete and confirm a logocentric theology" (Derrida, Positions 35). Such acts are not innocent but remind us how frequently mathematics has situated itself within logocentric narratives in order to validate its accomplishments and proclaim its universal potential. Deconstruction cannot be restricted to literary theory or philosophy; it also challenges scientific discourse to acknowledge the ways that it remythologizes itself by appealing to foundational myths present within Western tradition or to myths generated by the history of science.

Although Derrida challenges us to notice how mathematics may be emplaced by metaphysical narratives, mathematics also allows us to recognize how deconstruction itself is emplaced. Rather than legitimating its inquiry through metaphysics, deconstruction explains its own formulation of a science of writing or grammatology through mathematics. In Derrida’s effort to criticize how phonetic writing generates appeals for transcendent validation, mathematics offers a strategic means for standing outside ordinary phonetic writing. In effect, the notational independence of mathematics offers Derrida a locus for thinking beyond metaphysical systems that invariably seek to find closure. From his commentary on Husserl’s Origins of Geometry to more recent work such as The Truth in Painting, Derrida describes his work in reference to mathematics. The reasons for such a strategy are not arcane. In contrast to ordinary phonetic language which bears a myriad of transcendent operations, mathematics offers a neutral system of notation that makes no appeal for metaphysical closure. In contrast to chaos theory, which emplots itself within logocentric narratives, deconstruction emplots itself within what we might call geocentric or mathemocentric narratives.

Consider the following examples. For Derrida, a problem avoided by Husserl—the difference between phonetic and nonphonetic writing—becomes central. The problem signaled in The Origin of Geometry and Speech and Phenomena becomes foregrounded in Grammatology, where the formulation of a science of writing is made possible by the expanding complexity of nonphonetic notational systems. "The science of writing should therefore look for its object at the roots of seciency" (Derrida 27). Fittingly, the eighteenth-century schemas for universal languages reviewed in Grammatology register not only a frustration with the inadequacy of encasing metaphysical systems, but acknowledge the possibilities offered by mathematics. An important prise de conscience regarding mathematics appears in an exchange between Derrida and Julia Kristeva in Positions:

A grammatology that would break with this system of presuppositions, then, must in effect liberate the mathematicization of language, and must also declare that the practice of science in fact has never ceased to protest the imperialism of the logos, for example by calling upon, from all time, and more and more, nonphonetic writing. Everything that has always linked logos to phone has been limited by mathematics, whose progress is in absolute solidarity with the practice of a nonphonetic inscription. (34)

The linkage between deconstruction’s defiance of metaphysical closure and the development of mathematics is made even more explicit as the discussion continues.

The effective progress of mathematical notation thus goes along with the deconstruction of metaphysics, with the profound renewal of mathematics itself, and the concept of science for which mathematics has always been the model (35).

The passages are important, for they indicate how completely Derrida privileges mathematics. At the same time that mathematics offers a model for the radical destabilization of phoneticism, it provides grammatology with a stabilizing force because it denotes grammatology’s goal. The reference to the “imperialism of the logos” set against the “effective progress of mathematical notation” dramatizes a clash between notational systems. While Derrida challenges his readers to deconstruct logocentric narratives, he uses mathematics—and particularly the radically different notational system of mathematics—to emplot his own critical inquiry.

The place of mathematics in Derrida’s work extends well beyond overt references. The references to mathematics, especially as a sign system that escapes metaphysical enclosure, permit us to see how Derrida has gener-
and a sign system that may also subvert metaphysical enclosure. Such a system emerges not from mathematical notation but in the metaphorical play that abounds within Derrida's work. In effect, Derrida's neologisms, which cause such problems for some readers, mark a step toward a new calculus that would interrogate our propensity to build and enforce systems. In contrast to metaphysical discourse that would enclose and defend, Derrida provokes continual openings. Critical figures—différance, supplement, aporia, trace—register such boundary work. Deconstruction's abundant deployment of terms is a graphic mechanism for provoking the reader to stand out and question how a text achieves meaning. While chaos theory inscribes its work on an evolving body of mathematical practice (particularly within phase space or Poincaré sections), deconstruction has no such established heuristic form. Indeed, in the absence of such a form, deconstruction plays with the possibility that the inscriptions of ordinary language work as a kind of phase space being stretched and folded on the rectangle of the written or printed page. Derrida's terms are not promiscuous agents but are like the graphic markers in mathematical equations. Each pertains not to a single universalized function but to a particular setting.

The foregoing discussion could certainly be extended. For now I can only make a general observation. Derrida's appeal to mathematics as a force to counter the imperial inscription of logocentrism seems to rely on an idealized conception of "pure" mathematics. Given the applied context of mathematics present throughout science and engineering, Derrida seems to exaggerate its substantive power as a nonphonetic system of inscription. All mathematics may be viewed as intersecting with phonetic language. In fact, the logocentric employment of chaos theory noted above challenges Derrida's supposition that "[t]he effective progress of mathematical notation... goes along with the deconstruction of metaphysics" (35). Although Derrida's own description of mathematics makes it appear decontextualized from its phonetic setting, it seems to use to its cost: grammatical system's own unfolding story. Rather than pursue such questions any further, I will now turn my attention to the narrative functions that are at work in chaos theory and deconstruction on the local level.

II. Examples as Forms of Local Narrative

So far I have noticed how deconstruction and chaos theory employ their inquiry. Whereas chaos theory becomes emplotted through logocentric narratives by practitioners who would validate their enterprise, Derrida emplots deconstruction by literally asking his reader to think of writing as a form of mathematical notation. The local narratives that deconstruction and mathematics offer a means to develop the consideration of emplotment even further. By local narrative, I mean the shorter narrative operations present in disciplines as well as in our daily activity. These narratives include everything from instructions or directions (medicine bottles, telephone books, computer manuals) to cartoons on postmodernism in The Village Voice. Such mundane forms occupy our attention much of the time and have become a focal point in disciplines like psychology, linguistics, and artificial intelligence because they provide access to assumptions present in more complex discourse. While postmodernism has become criticized for being an ideological justification for a bric-a-brac culture, its inquiry also emerges from the recognition that the most fragmented events provide access to cognitive acts at all levels of cultural discourse. The spectacle of talking and dancing food in the refrigerator of Pee Wee's Playhouse reminds us of the unacknowledged stories present in all objects that surround us. An awareness of the myriad of narratives that surround us at every moment causes Mikhail Bakhtin to observe that "he is near voices everywhere" (quoted in Todorov 21). In what follows I will concentrate on a function central to all local narratives: exemplification.

Our use of language relies on examples. We learn language through examples and continually use examples to orient ourselves within discourse. If we wish, we may think of examples as providing surveying tools that help orient our discourse with others. Practically, examples comprise appeals that would establish a common terrain for listeners or readers. Seen in this way, communication functions through an elaborate network of exemplification. Examples help us make points and enforce stability, but they also open discourse by challenging an audience to revise the maps they have used to plot experience. Finally, examples remind us that all understanding is temporally mediated.

We may formulate the major narrative functions associated with exemplification as follows:

1. Examples promote closure: Closure does not occur in a simple manner but has teleological implications on several levels. Closure may appear as a specific answer, affirm the coherence of an abstract system, and even bring credibility to the person responsible for the solution. At the same time, closure does not mark the termination of a rational process but invites the problem solver to test the result by working the answer back through the preceding narrative.

2. Examples provoke openings: Comprehension of an example pro-
emetes its extension to other phenomena. Once an example is understood, it may be adapted to multiple settings with the result that each application further demonstrates the authority of the abstraction.

3. **Examples may subvert the system they are intended to affirm.** If solutions other than those dictated by the system are discovered, the entire system may be tested, resulting either in its elaboration or refutation.

Within the tradition of Western rhetoric, *entithememes* are regarded as instruments that may contribute to a larger argument. In effect, the student of Aristotle or Cicero is taught to think of the example as a disciplined foot-soldier to be used in the execution of a larger strategy. The enthymemes that contribute so vitally to the discussion in Aristotle's *Poetics* and *Politics* become themselves the object of inquiry in the *Rhetoric*. Here discussion centers not on the overarching argument but on the evidence a speaker uses to forward a position. By selecting an example that is appropriate for an audience, the speaker may control the point of the example. Conversely, an ill-chosen example may blunt the speaker's argument by diffusing or scattering the audience's attention. For Aristotle, an enthymeme comprises a miniature argument and should be thought of as a syllogism. Aristotle distinguishes two primary enthymemes.

There are two primary species of enthymemes, namely: 1) **Demonstrative Enthymemes**, which prove that a thing is, or is not, so and so; and 2) **Refractive Enthymemes**, which controvert the Demonstrative. The difference between the two kinds is the same as that between syllogistic proof and disproof in dialectic. By the demonstrative enthymeme we draw a conclusion from consistent propositions; by the refractive we draw a conclusion from inconsistent propositions. (*Rhetoric* 2.22)

In later rhetorical manuals such as the *Rhetorica ad Herennium*, the demonstrative enthymeme becomes ground not only for closure but for testing premises. "**Exempla are not distinguished for their ability to give proof or witness to particular causes, but for their ability to expound these causes.**" While an exemplum is graphically abbreviated, its rational expansion takes place in silence in the mind of the listener or reader. In essence, the figure works as a muted logical statement that supports the more developed argument of a larger narrative through abbreviation. The definition of exemplum notices an assumption about its use that is frequently ignored. Use of an exemplum should direct attention not to the result, but to the cause. Often we mistakenly assume that an exemplum would simplify discourse, when it actually works towards its complication. Rather than working as a simple syllogism, the figure works as a vehicle for elaboration. Salvatore Battaglia notices that the exemplum provided the Middle Ages with a means to investigate daily life and for this reason may even be regarded as a counterforce to the Bible (467). The remarkable expansion of scientific discourse in the seventeenth century came about through a proliferation of examples. The examples of natural phenomena that the Middle Ages and Renaissance controlled with compendia provoked renewed investigation by the seventeenth century. In fact, the exploration of physical phenomena may be compared to the proliferation of commentaries on *fabulae*. Phenomena included in Aristotle's *Parva natura* or Ovid's *Metamorphoses* are no longer moments of definitive closure, but sites for expansion (Knospel). In the study of physics and mythography alike, the reader must not only resolve the meaning of an example but simultaneously locate it within the experience of the evolving narrative. Response to the example requires that attention given to the causes figured within the short narrative also extend to exploration of their presence within the evolving narrative as well as the already experienced narrative. Examples are narrative ligatures essential in making sense of our progression within texts. The three levels of narrative representation discussed by Paul Ricoeur—prefiguration, configuration, refiguration—offer a helpful way for thinking about the expectancy that accompanies examples. Anticipating how an example will fit a particular context marks a moment of prefiguration which is subsequently followed by stages in which its prefigured significance molds into the evolving configuration of the text. Finally the example itself may bring about refiguration of the entire text (52–87). The example is an advantageous figure with which to consider reading because it not only disrupts our viewpoint by making us refigure the fable but also offers a potential frame for ordering our assimilation of the story. The example functions something like a scenic overview that we may turn into while driving through the countryside. Like the overview which invites the driver to temporarily suspend his progress to consider the terrain he has crossed, the example invites the reader to consider his progress within the text.

The importance of *exempla* in the Middle Ages and Renaissance identifies an impetus for the renewed examination of exemplification within discourse. Their central position within classical rhetorical tradition explains their prevalent position in all forms of discourse before the rising preoccupation with building and maintaining physical and metaphysical systems in the eighteenth century. Today we witness a renewed interest in the local event simply because we have learned of the limited efficiency of universal claims. Work by André Jolles and Hans Robert Jauss on medieval discourse may be extended to contemporary discourse as
well. Lyotard's work suggests that we should recognize far more than we do the place of the shorter narrative forms within scientific discourse (22). Similar arguments appear in the discussions that use biological metaphors to describe networks of communication. When Gilles Deleuze, Félix Guattari, and Michel Serres use biological metaphors such as the "rhizome" or "parasite," they insinuate the presence of narrative units as rhizomes that affect the nature of discourse as a whole (Thousand Plateaus, Parastie). Local narratives have not disappeared but are becoming more crucial to our critical understanding of all forms of discourse.

Enthymemes are hardly insignificant within discourse. They are narrative forms central to the ways we test and assimilate experience in the human as well as the natural sciences. Any experience presents itself as a potential example. An example may consist of a single word in a novel used to demonstrate a point or may comprise the entire novel itself. While one day we may work to build a complex argument with an exemplary experience, the next day we may collapse the grandest argument into an example. A major feature of discussion within the human and natural sciences is a reliance on the exemplification of highly complicated theoretical matter. While such abbreviation is a sign of scientific discourse, it may also lead to a suspension of communication if the audience does not understand the abbreviations used. The consideration of examples reminds us that our communication virtually consists of relaying examples that we would use to support and test abstractions. It is not an exaggeration to think of examples as forming the very currency of our exchanges.

The sciences are made up of examples. If we think of all experiments as examples that would test or demonstrate the validity of natural principles, we find that, rather than repudiating examples, the sciences privilege them. In the introduction, I noticed the productivity of contemporary discourse to exaggerate metanarratives. Overarching narratives are hardly removed from examples but bear assumptions about their significance. Consider Kuhnian paradigms. Although the paradigm would order an array of examples (normal science), it is also through the anomalous example that the paradigm is transformed. Although scientific discourse may be simplified by describing it as paradigm dependent, its complex activity becomes more apparent if we approach it through the examples on which it depends. Bruno Latour makes this point repeatedly in Science in Action. In contrast to Kuhn who identifies the paradigm shifts in the history of science and the ways they order the myriad of local narratives, Latour concentrates on the exemplary inscriptions that actually make up the practice of scientific discourse. By looking at science in action rather than the history of science—laboratory science rather than museum science—Latour is able to show scientific activity as a contest involving the generation and coupling of examples.

Word problems in mathematics are a particularly advantageous place to explore scientific exemplification. Viewed historically, story or word problems form an ever-present body of short narratives. They are a fundamental vehicle for teaching mathematics and remind us that science as we know it cannot proceed without them. Pedagogically, story problems may be compared with the examples used in a sermon or the anecdotes used in a classroom because they furnish us with a means for dealing with abstractions. Their importance extends beyond formal education: we generate word problems in applying mathematical principles to the world. Such narratives make solutions possible, for they define the phenomena under consideration, formulate relationships between different phenomena, and generally prepare for the translation of linguistic configurations into mathematical notation. The pervasive presence of such forms within education and application indicates the extent to which mathematics may be regarded as a discipline that is committed to the world. While "plot" bears an idea of measurement when used to describe narrative structure, it also challenges us to recognize how the action of "plotting" within a coordinate system denotes an expectancy that has already been narratively encoded. Examples, and more particularly story problems, constitute a crucial narrative mode for negotiating understanding in all disciplines. Just how crucial they are becomes apparent when we look at their place in deconstruction and chaos theory.

III. Playing with Examples

In the first part of my discussion I noticed that efforts to draw together chaos theory and deconstruction are challenged by deconstruction's impulse to call into question the logocentric narratives used to validate the mathematical theory. In the second part I suggested that local narratives offer a hermeneutically rich setting for looking at the way audiences within the human or natural sciences negotiate understanding. In the final section I will suggest that the relation between deconstruction and chaos theory opened in the first section can most profitably be pursued by considering the way these theories deal with local narratives.

One of the obvious yet overlooked aspects of chaos theory is its practical application. Although chaos theory certainly bears implications for mathematical theory, it has attracted attention within scientific disci-
plines because it provides a means for describing an array of natural phenomena. Research on deterministic chaos has already had great impact on several fields, including chemistry, biology, and physics. It has a bearing on fluids near the onset of turbulence, lasers, chemical reactions, particle accelerators, biological models for population dynamics, and cardiac care. Benoit Mandelbrot's computer-enhanced images of iterative functions have extended its application. These applications of chaos theory make it into a virtual generator of examples. My colleague Ron Fox has observed that

the general picture of nonlinearity got a lot of people's attention—slowly at first, but increasingly. . . . Everybody that looked at it, it bore fruit for you now look at any problem you looked at before no matter what science you're in. There was a place where you quit looking at it because it became nonlinear. Now you know how to look at it and you go back. (Quoted in Gleick 305–6)

Chaos theory does not only direct attention to a specialized area of metamathematics but redirects attention to specific local phenomena. One important implication of such work is the way it has challenged mathematics to become less of an idealized end more of an experimental science.

The invitation for pedagogical play marks more than a renewal of applied mathematics. It challenges the top-down model of teaching mathematics and promotes the convergence of mathematical intuition with everyday experience. Chaos theory, as Steven Wolfram has suggested, challenges mathematics from the ground up. The "evangelical" conclusion to Robert May's seminal article on chaos from 1976 makes a similar point.16 Benoit Mandelbrot's work—and indeed his career—is an example of the reorientation of applied mathematics. He has called Fractal Geometry of Nature "a manifesto and a casebook" (104). The book provokes expectation that phenomena hitherto ignored in chemistry, biology, and physics can be approached through the study of complexity and suggests that the history of science itself may contain evidence of earlier efforts to comprehend such complexity. After meeting Mandelbrot at a Cornell seminar in the fall of 1986, I shared with him a project exploring the ways the Renaissance mathematicians approached Euclidean geometry through the practical geometry of Archimedes. By the next day, Mandelbrot was asking detailed questions about Archimedes and looking through medieval and Renaissance treatises himself.

The pedagogical play provoked by chaos theory also appears in deconstruction's analysis of texts. Indeed, such play negotiated through the local narratives provoked by each theory may be a more useful means of comparing such forms of mathematical and linguistic analysis than excessive emphasis on instability. Deconstruction, like chaos theory, is a form of analysis that begins with a local problem. Each engages in logical analysis for the study of problematic phenomena and identifies habits of investigation that have come to privilege themselves. By analyzing marginal or boundary situations, these modes bring into range phenomena that have been avoided. The broad range of Derrida's own investigations offer an indication; they all are examples. Moreover, they are examples in a significant manner. Rather than demonstrating closure as in a syllogism, they open inquiry. Consider Derrida's observation at the very beginning of Grammatology. Referring to the second part of the book, concerned with Rousseau's Essay on the Origin of Language, he writes:

This is the moment, as it were, of the example, although strictly speaking, that notion is not acceptable within my argument. I have tried to defend, patiently and at length, the choice of these examples (as I have called them for the sake of convenience) and the necessity for their presentation. (lxxiv)

Derrida's qualified use of "example" comes from an awareness that examples are frequently used to demonstrate a closed system. Whether one considers collections of biblical parables, mythographic handbooks from antiquity through the Renaissance, histories of philosophy or of science, or even the Platonic theory of forms itself one discovers example—indeed paradigm—placed in containers and ready to use as prescribed. In complete contrast to "canned" examples applied with definite prescriptions, Derrida initiates a move away from closure and towards opening and extension.

As we compare chaos theory and deconstruction, we notice in each the crucial importance not of axiomatic or systematic statements but of examples. For each, examples provide a stable means for exploring instability. Their stability, however, is not conventional in the sense that it would enforce allegiance. Rather it is the stability that accompanies anything used as a heuristic devise. Examples become phenomenologically rich sources, a means not only of simple affirmation but also of extending inquiry. We may follow such extension by comparing it to the play of surplus meaning or information that follows an interpretive act.19

Surplus meaning refers to the complex psycho-linguistic phenomena which are generated by interpretive acts but which remain unacknowledged in the formulation of a response. Surplus information pertains to data which may be quantified but not necessarily comprehended through a single formulation. In the case of nonlinear equations, the erratic behavior of a dynamic system in one scale may urge the scientist to alter the parameters used to deploy and interpret the data. In the case of deconstruction, figurative language hitherto read into a traditionally en-
forced meaning of a text is allowed to play within a larger spectrum of meaning. Far from explicating the text for itself, deconstruction asks how the language of a particular text becomes the register or reservoir for astonishingly absent ideas such as being, the mind, or the subconscious. In chaos theory and deconstruction alike, the expectation of surplus meaning works to open the system to reinterpretation. Each project holds open the possibility of extending the strategies available for analysis. It does so not through a single interpretive act but through a process of iteration. Deconstruction, rather than reading a single text a single time, promotes the reading of many texts many times for an ongoing confessional comprehension of how meaning is generated.

In their efforts to articulate surplus meaning and surplus information, deconstruction and chaos theory account for ongoing phenomena. Chaos theory describes a new kind of order but finally also relies on previous mathematical models as heuristic tools. Deconstruction also relies on models but models of reading and interpretation that have become habitual and even unconscious. For each, an understanding of how inquiry validates itself through limits promotes an awareness that symbolic systems also outrun preexistent meaning. Merleau-Ponty referred to critical acts as "that paradoxical operation through which by using words of a given sense, and already available meanings, we try to follow up an intention which necessarily cutstrips, modifies and in the last analysis stabilizes the meanings of the words which translate it" (quoted in Norris 32). Deconstruction's work has been directed toward the amplification of such surplus. Rather than repressing such surplus or assuming that it fits into a preconceived system, Derrida would use it as a vehicle for asking how a text works. An idea of surplus works within disordered systems studied by chaos theory as well; such surplus becomes apparent when we recognize the watchfulness with which apparently chaotic systems are regarded. Where disorder was seen in the past, new forms of order now manifest themselves. Changing forms of representation—the replacement of classical Cartesian coordinates with the time-series diagrams of phase space—contribute to an expectancy for new patterns. Probably the most graphic images of "surplus" within chaos theory come from the paisley-like patterns of Mandelbrot's fractals which swirl into ever-new openings. From such a position we may understand the important affinity between deconstruction and mathematics. Both presume a continuous proliferation. By articulating disorder, by decentering what appears as a privileged text, chaos theory and deconstruction intervene to make us aware of other forms of order. Just as chaos theory seeks to define order which has hitherto remained undecipherable, deconstruction exposes experience which has been "ignored in order to preserve the illusion of truth as perfectly self-contained and self-sufficient presence" (Kearney 106).

IV. Openings

Deconstruction and chaos theory complement as well as challenge each other. Deconstruction cannot simply embrace chaos theory as a destabilizing ally but requires practitioners of chaos theory to recognize how the employment of their discipline contributes to its destabilization and mythification. Chaos theory in turn challenges practitioners of deconstruction to recognize how thoroughly Derrida uses mathematics to stabilize his graminatology. By following the ways each discipline emplots and authorizes itself through reference to the other, we discern a crucial way that disorder becomes ordered. But while we learn much by identifying how the disciplines map themselves into each other, we learn even more by looking at the way each is occupied with exemplification.

Rather than using examples to bring about closure, each maps its enterprise through the proliferation of local narratives that attest to the instability within discourse. Examples, however, also provide heuristic stability by marking moments in an evolving discourse. The instability discerned and analyzed by deconstruction and chaos theory should not be fetishized through overarching metanarratives. Inquiry with the natural and human sciences is not simply a matter of theoretical paradigms but involves the engagement with and generation of a myriad of local narratives. Science, as well as cultural discourse, cannot afford to orient itself through theoretical master plans alone but needs to consider the smaller narratives that bring order out chaos.

At a time when it is tempting to emphasize the complementarity of deconstruction and chaos theory, we must also acknowledge their differences. While deconstruction subverts efforts to make itself into a universal system, chaos theory is explicitly regarded as a frontier for a new foundational synthesis. The fact that deconstruction challenges the impulse to build overarching systems separates it from the inclination to view chaos theory as the entry way to a new scientific orientation. The difference should be stressed, for it calls into question efforts to exaggerate their affinity on logical grounds. Rather than being caught in a longing for an all-inclusive metatheoretical position, we should work to understand how local narratives render stable the destabilizing methods made available by deconstruction and chaos theory. Ultimately, the employment of chaos arises less from universal expectations than through a multitude of local narratives.

In a well-known paragraph in his Philosophical Investigations, Witt-
In his introduction to Lyotard's book, Jameson makes the following challenge:

4. While we may no longer accept the theoretical synthesis offered by neokantian philosophy or phenomenology, we may still learn from their rigorous grounding in science. Ernst Cassirer's work on relativity and quantum mechanics (Substance and Function and Einstein's Theory of Relativity [bound together] (New York: Dover Publications, 1953 [1920]) remains a model of interdisciplinary literacy. An unfortunate consequence of phenomenology's assimilation into Anglo-American literary theory is the presumption with which it would speak about the assimilation of knowledge at the same time that it is virtually silent before science. In its American setting, phenomenology has turned from inquiry grounded in mathematics and science and emphasized psycho-linguistic epistemology. The arrogance present in certain literary theory that would absorb virtually everything in a handy epistemological schema exemplifies the filtered reception of such philosophical work. We live in a period that has come close to proclaiming universal theories of knowledge based on the analysis of a single literary or philosophical text. Under these circumstances it is not the sciences that threaten to 'explain' the humanities but theorizing humanists who make claims to account for the sciences. I want to acknowledge such problems at the outset because they challenge us to formulate even more rigorous grounds for interdisciplinary work between the natural and human sciences. See also John Michael Krois, Cassirer: Symbolic Forms and History (New Haven: Yale University Press, 1967).

5. See also The Cosmic Web: Scientific Field Models and Literary Strategies in the 20th Century (Ithaca: Cornell University Press, 1984); for Hayles's most recent account of chaos theory and deconstruction see 'Chaos as Ordinarily Disorder: Shifting Ground in Contemporary Literature and Science,' New Literary History 20:2 (Winter 1989), 315-22.

6. The noun "plot" referring to a small area or small piece of ground comes from late Old English probably before 1100. The noun "plot," referring to a secret plan or conspiracy, is traced to the Old French word complet. See OED and The Barnhart Dictionary of Etymology ed. Robert K. Barnhart (New York: H. W. Wilson, 1988) for the relation of "plot" as a small piece of ground or patch and "plague" and subsequent links to Greek and Latin, see Eric Partridge. Origins: A Short Etymological Dictionary of Modern English (London: Routledge & Kegan Paul, 1958).

7. The earliest reference to "plot" within the context of mapping appears in Robert Recorde's Pathway to Knowledge (London, 1551). Referring to the geometric quadrant, Recorde writes that you may use the instrument 'not only to measure the distance at one of all places that you can see together, howe muche
13. Prigogine cites Goethe's Faust at the beginning of From Being to Becoming, p. ix.


17. Steven Wolfram emphasized this point in a conversation with the author at Cornell in November 1986.

18. The most important applications, however, may be pedagogical. The elegant body of mathematical theory pertaining to linear systems (Fourier analysis, orthogonal functions, and so on) and its successful application to main fundamentally linear problems in the physical sciences, tends to dominate even moderately advanced university courses in mathematics and theoretical physics. The mathematical intuition so developed ill equips the student to confront the bizarre behaviour exhibited by the simplest of discrete nonlinear systems... Yet such nonlinear systems are surely the rule, not the exception, outside the physical sciences. Not only in research, but also in the everyday world of politics and economics, we would all be better off if more people realized that simple nonlinear systems do not necessarily possess simple dynamical properties.

May refers to this conclusion as "evangelical" on page 429.

19. See Hayles for a detailed comparison of deconstruction and information theory.

Works Cited


