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INTERPHYSICS: POSTDISCIPLINARY APPROACHES TO LITERATURE AND SCIENCE

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WHAT NOW? AN INTRODUCTION TO INTERPHYSICS

Postdisciplinarity is always an exercise in transgression. One of its suitable metaphors may be the near universal experience of jumping the wall, at night, and finding yourself and two or three of your friends in a graveyard. One of you wants to look into tombs or pry open coffins; one of you has a serious case of the jitters and keeps whispering, with increasing urgency, "We're gonna get *caught!*"; and one of you is hanging about two paces back wondering, what now? what price do we pay for transgression?

The emerging metafield of Literature and Science has already jumped the wall, and as its practitioners—literary critics and theorists, psychologists, philosophers, sociologists, anthropologists, historians, and increasing numbers of "hard" scientists—seem pretty well scattered throughout the graveyard. To expect some sort of ideational, ideological, or thematic unity from the writings of these critics is to miss or to underestimate the radical—the destabilizing and often disorienting—effects of finding oneself over the wall, of transgressing disciplinary boundaries. The recent proliferation of work in the field—special issues of journals, collections of essays, and increasing numbers of books—suggests that Literature and Science may be more than simply another fad or the embryonic stirrings of a new orthodoxy; potentially, at least, it points toward a transformation of knowledge within and beyond the university.[1]

In different ways, the essays collected in this special issue of the *New Orleans Review* testify to the potential of postdisciplinary study to question received ideas, interpretations, and languages, to demystify the "natural" ways in which literature, science, philosophy, and history construct the physical—and metaphysical—universe. Although these essays exhibit no party line, although they draw on different vocabularies to offer a variety of critiques of the structures of disciplinary knowledge, they share a basic presupposition about the ways in which language—or any semiotic system—interacts with the physical reality that it describes: language is never simply a transparent medium but always a constitutive and material construct. This realization, of course, is not something new to literary theorists, for example, or to constructivists in the history, philosophy, and sociology of science. But the implications of the materiality of language and representation, as Katherine Hayles argues below, have not really been assimilated even by many of those individuals who are busy overturning tombstones in their respective academic disciplines. What is at stake in postdisciplinary investigations of the kind that appear in this special issue are, in an important sense, the basic assumptions of Western thought since Plato and the structures of disciplinary knowledge since Kant.

Western philosophy traditionally has taken as one of the grounds of its project the separation of physics from metaphysics, of the study of the natural world from the contemplation of that which transcends the contingencies of historical time and space.[2] The etymology of the term

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[1] The bibliography on Literature and Science has grown dramatically during the past five years. For representative collections and works, see George Levine, ed., *One Culture: Essays on Science and Literature* (Wisconsin: Univ. of Wisconsin Press, 1987); Fred Amrine, ed., *Literature and Science as Modes of Expression* (Dordrecht: Reidel, 1989); Stuart Peterfreund, ed., *Literature and Science: Theory & Practice* (Boston: Northeastern Univ. Press, 1990); the special issues of *Annals of Scholarship* (1986), ed. G. S. Rousseau, and of *Studies in the Literary Imagination* (1989), ed. John Hannay; Katherine Hayles, *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* (Ithaca: Cornell Univ. Press 1984), and *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca: Cornell Univ. Press 1990); William Paulson, *The Noise of Culture: Literary Texts in a World of Information* (Ithaca: Cornell Univ. Press, 1988); and Mihai Spariosu, *Dionysius Reborn: Play and the Aesthetic Dimension in Modern Philosophical and Scientific Discourse* (Ithaca: Cornell Univ. Press, 1989). Collections of essays on Literature and Science, as of this writing, are forthcoming from the university presses of Chicago, Southern Illinois, Texas Tech, and Lehigh; Wisconsin, Oklahoma, and Peter Lang all have series devoted to postdisciplinary approaches to Literature and Science.

"metaphysics" itself suggests a view of nature as inadequate and corrupt, as the realm of mutability rather than of essential existence. In the intersecting discourses of seventeenth-century science and theology, as Desiree Hellegers argues, physical reality is accorded only a second-order status as the manifestation of God's omnipotence. Throughout the eighteenth century, as Molly Rothenberg and Stuart Peterfreund demonstrate, science is marked by the "traces" of a Protestant theology which constructs the physical world as precisely that which must be exploited and controlled. In this regard, different forms of Western thinking—from Baconian empiricism to idealist philosophy—have long struggled to maintain a fundamental opposition between physics and metaphysics, between the body and the soul, between the world and the heavens. In practice, each element of these oppositions functions dialectically as a guarantee of the epistemological and ontological self-sufficiency of the other. However antagonistic the two cultures—the humanities and the sciences—have often seemed, each needs the existence of the other against which to define its own claims to represent a transhistorical "truth."[3]

Since the seventeenth century, the arguments for the separation of the two cultures have taken a variety of forms. Yet the efforts expended to defend the territories claimed by "science" and the "humanities" often seem an ironic measure of the instability of the distinction between them. What we call, at least traditionally, the history of science—the Whiggish progression of great experimenters and inventors extending humankind's knowledge toward an implicitly or explicitly millenarian future—can be seen, in one sense, as a series of strategies of repression designed to control the instability, the turbulence of both nature and representation. Narratives of scientific progress depend upon imposing binary oppositions—true/false, right/wrong—on theoretical and experimental knowledge, privileging meaning over noise, metonomy over metaphor, monological

authority over dialogical contention. As Katherine Hayles and Bruce Clarke demonstrate below, these attempts to fix nature are ideologically coercive as well as descriptively limited. They focus attention only on the small range of phenomena—say, linear dynamics—which seem to offer easy, often idealized ways of modeling and interpreting humankind's relationship to the universe. The consequences of linearity, as Sharon Stockton argues, include narratives which reproduce the strategies of ideological control that they ostensibly seek to analyze—whether in Virginia Woolf's novels or in the narratives that comprise traditional histories of cosmology.

Literature and Science, in this respect, is less a carefully demarcated field of study than an ongoing process of deconstructing the seemingly fundamental distinction between physics and metaphysics. A couple of years ago, I coined the term *interphysics* to describe postdisciplinary strategies of thought and representation that radically challenge— epistemologically and institutionally— disciplinary boundaries. Although I'm still waiting for a groundswell of scholarly opinion to canonize "interphysics," the term seems a fair way to invoke an alternative to what Michel Serres calls "thanatocratic" science by promoting modes of inquiry which escape from and subvert the logic of determinism.[4] Interphysics reads the histories and the methodologies of science, philosophy, and history against themselves; as the essays in this issue by Rothenberg, Peterfreund, and Michele Birnbaum suggest, it insists on the materiality of representation, on the political consequences of those strategies of thinking and writing which, as Hayles argues, are never unmediated, which always construct and intervene in our relationships to our environment. The metaphors that inform interphysics are those of chaos theory, ecology, fluid dynamics, and hadron bootstrap theory. All of them characterize a political as well as an ideational rupture within disciplinary divisions of knowledge. In this regard, as Nancy Mergler and Ronald Schleifer maintain, interphysics marks a revaluation of semiotic modality in linguistics, psychology, physics, and critical theory. It explores both the scientific and cultural

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[2]I treat this problem in greater detail in "From Kant to Chaos: Physics, Metaphysics, and the Institutionalization of Knowledge," *University of Hartford Studies in Literature* 22 (1990), forthcoming.

[3]See Betty Jean Craige, *Reconnection: From Dualism to Holism in Literary Study* (Athens: Univ. of Georgia Press, 1988).

[4]Michel Serres, *Hermes: Literature, Science, Philosophy*, trans. and eds., Josue V. Harari and David F. Bell (Baltimore: Johns Hopkins Univ. Press, 1982).

implications of complexity, investigating the dialogical interactions of order and disorder across a variety of specialized fields.

In its various critiques of disciplinary knowledge, interphysics draws upon, and intersects with, contemporary theoretical, feminist, and marxist thought to challenge traditional configurations of science and power. As Eric White's essay suggests, the work of Michel Serres has been crucial during the past decade to the development of Literature and Science as a postdisciplinary area of inquiry. Serres' cross-disciplinary investigations of literature, history, science, and philosophy are consciously a-systematic but differ significantly from, say, the work of François Lyotard on postmodernism.[5] While Serres, like Lyotard, rejects the notion of metanarratives, he does not identify this decentering of authority with a particular historical moment in the late twentieth century; his work ranges instead over the whole history of Western science since the time of Thales: Lucretius, Descartes, and Leibniz, among others, figure prominently in his interrelated narratives of complexity and monadology. Serres, though, is less a father-figure or an authoritarian presence in Literature and Science than a kind of historical marker—as Clarke suggests, Serres' work provides a heuristic of resistance to challenge the deterministic tendencies of Western science. Both the politics and metaphorics of resistance weave their way throughout the essays in this issue. Interphysics resists traditional notions of order and of scientific argumentation. In one sense, it suggests that we need to reconceive our ideas of unity, of coherence; it forces us to ask ourselves what essays on Donne's theology, the excremental waters of eighteenth-century Bath, and the relationships between language and quantum physics have to do with one another. If we expect the essays by Hellegers, Rothenberg, and Valerie Greenberg to provide definitive answers, we may be disappointed: to move, in Serres' vocabulary, from Mars to Venus, from thanatocratic science to an ecology of energy and fluid dynamics, is to recognize ultimately that interphysics, like other forms of knowledge and other strategies of representation, can always and only be an epistemological heuristic.

The affinities of interphysics with marxist and feminist critiques of science, though, raise some crucial political questions. Is it possible to offer radical reformulations of science without relying on the kinds of totalizing alternatives which, I have argued, Literature and Science ostensibly rejects? If, however, we relinquish claims to rhetorical and political authority, if we emphasize interphysics as a heuristic, do we also give up our agenda to transform structures of knowledge? Similar dilemmas have confronted feminists and politically-oriented critics in recent years. There are, of course, no simple answers to these questions. But they do suggest that postdisciplinary writing and teaching is dialogical, that it must embrace efforts, in Donna Haraway's words, "to build an ironic political myth faithful to feminism, socialism, and materialism."[6] Bakhtin's description of a "dialogics of culture"—a contested field of competing languages that are always politically and economically contingent—is useful in emphasizing that interphysics is not about consensus-building, although the contributors to this issue share some general areas of theoretical, and political, agreement.[7] If I had more time, it would be interesting to read the various essays collected here precisely for their differences, to find ways to provoke debate among the contributors and among the theorists they use and cite. What the history and philosophy of science often write out of existence—or turn to binary oppositions between scientists who have been proved "right" and those who have been proved "wrong"—are the complex dynamics of contention. Traditional debates within the philosophy of science—the realists versus constructivists, for example—mystify the ideological and socioeconomic implications of scientific thinking and practice. To read the margins of science, as Rothenberg notes, is to resist reconstructing the history of science in our own terms: in effect, it is to resist "science"—and "literature"—altogether.

Interphysics is perhaps best left, then, with its

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[6]Donna Haraway, "A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s," *Socialist Review* 1985: 65-107. On feminist approaches to science, see also Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale Univ. Press, 1985).

[7]See Mikhail Bakhtin, *The Dialogic Imagination: Four Essays*, ed. Michael Holquist, trans. Caryl Emerson and Michael Holquist (Austin: Univ. of Texas Press, 1981).

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[5]François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: Univ. of Minnesota Press, 1984).

manifesto to emerge in and among the various metaphors that constitute it: as resistance, as dialogic and subversive rereading, as the movement toward a complex ecology of thought, representation, and action. The question in my title is "what now?" rather than "what next?" to suggest that linear causality, the metaphysic of prediction, is henceforth open to question. In the 1990s, we seem to be whistling in, not by, the graveyard of deterministic, thanatocratic models of disciplinary knowledge.□

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Desiree E. Hellegers

THE POLITICS OF REDEMPTION: SCIENCE, CONSCIENCE, AND THE CRISIS OF AUTHORITY IN JOHN DONNE'S "ANNIVERSARIES"

Criticism of Donne's poetry has frequently obfuscated the nature of the poet's complex concerns with seventeenth-century natural philosophy by implicitly and explicitly imposing on his poetry ahistorical notions of science that misrepresent the relationship between natural science and theology.[1] Donne's approach to the New Philosophy, like that of his contemporaries, is conditioned by broader hermeneutical concerns, which, in turn, are inseparable from political and ethical issues. Following the Reformation, the politics of scriptural interpretation became the locus of epistemological controversy as it grew increasingly clear that the capacity of the individual to interpret scripture by means of the "inner light"—the claim which underwrote Protestant theology—could serve as a justification for challenging both political and religious authority.[2] Donne's approach to both language and the natural world can be seen as a response to the attempts of natural philosophers to circumvent the controversy over Biblical interpretation by establishing in nature a transparent representation of divine order which then could be used to legitimate a stable social order.[3] The "Anni-versaries" reflect Donne's concern with preserving the voluntarism of God and the interpretive freedom of the individual, concerns which are embodied in his acceptance of justification by Grace. The metaphor of the two books, the Book of Scriptures and the Book of Nature, is a constitutive element of the "Anniversaries," in which Donne attempts to mediate between two equally appropriate representations of the transcendence of God: unitary order and postlapsarian chaos. In this respect, the poems illustrate the complex relationship between Protestant theology and science and the extent to which disputes over the nature of the physical world are both implicated in and extend seventeenth-century debates over the nature of language.

Donne's awareness of the dynamics which underlie the problematics of interpretation and representation informs his approach to natural philosophy. For Donne, natural philosophy like all forms of postlapsarian representation is

[1]The most recent instance of this pattern in criticism is Thomas Docherty, *John Donne Undone* (New York: Methuen, 1986), who equates the New Philosophy with scientific materialism. See also Marjorie Hope Nicolson, *The Breaking of the Circle: Studies in the Effect of the "New Science" Upon Seventeenth-Century Poetry*, 2nd ed. (New York: Columbia Univ. Press, 1960); John Carey, *John Donne: Life, Mind and Art* (Boston: Faber and Faber, 1981) 245-53; and Charles Monroe Coffin, *John Donne and the New Philosophy* (New York: The Humanities Press, 1958). Other major critics of Donne's poetry, including Louis L. Martz, Helen Gardner, and Barbara Kiefer Lewalski, do not specifically address Donne's treatment of the New Philosophy.

[2]See Christopher Hill, *The Collected Essays of Christopher Hill*, vol. 2 (Sussex: Harvester Press, 1986). Hill argues that "The essence of protestantism—the priesthood of all believers—was logically a doctrine of individualist anarchy" (83).

[3]On the Royal Society's quest after 1660 for an "ideal semiotic" which will represent in Nature, as "Second Scripture," divine order, see Robert Markley, "Representing Order: Natural Philosophy, Mathematics, and Theology in the Newtonian Revolution," in *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles (Chicago: Univ. of Chicago Press 1991); and Markley, "Objectivity as Ideology: Boyle, Newton and the Languages of Science," *Genre* 16 (1983): 355-72. On the complexity of the relationship between Protestant theology and science, see also Brian Easlea, *Witch Hunting, Magic and the New Philosophy: An Introduction to the Debates of the Scientific Revolution: 1450-1750* (Sussex: Harvester Press, 1980); Markley, "Robert Boyle on Language: *Some Considerations Touching the Style of the Holy Scriptures*," *Studies in Eighteenth-Century Culture* 14 (1985): 159-71; J. R. Jacob, *Robert Boyle and the English Revolution* (New York: Burt Franklin, 1977) 133-80; Jacob, "Restoration Ideologies and the Royal Society," *History of Science* 17 (1980): 25-38; Jacob, "Restoration, Reformation and the Origins of the Royal Society," *History of Science* 13 (1975): 155-76; Richard S. Westfall, *Science and Religion in Seventeenth-Century England* (New Haven: Yale Univ. Press, 1958) 55-136; and E. A. Burtt, *The Metaphysical Foundations of Modern Science*, 2nd ed. (London: Routledge & Kegan Paul, 1934).

mediated by human agency and therefore, because it is historically and politically contingent, morally and theologically suspect. As a human semiotic, it is historically and politically contingent. In this sense, Donne's skepticism about natural philosophy anticipates recent cultural critiques of science, which acknowledge the inescapability of representation and challenge science's claim to transhistorical knowledge of the natural world.[4] For cultural critics, like N. Katherine Hayles, George Levine, and Joseph Rouse, science is a succession of metaphors, strategies, and disseminations of power, each of which predominates by virtue of particular political, cultural, and historical circumstances. A culturally-situated view of science provides a means to reexamine the relationship between epistemological issues and power relations in both the seventeenth and twentieth century. In this respect, historicizing the theory and practice of seventeenth-century natural philosophy may provide a critical vocabulary by which to explore Donne's critique of the New Philosophy —a concern of equal importance to the "libertine" Donne and the Dean of St. Paul's. The "Anniversaries," I shall argue, illustrate the extent to which Donne's poetic method is shaped by his critique.

Donne's skepticism about science is rooted in his profound suspicion of claims of disinterested interpretation. His poems reflect the awareness he shares with his contemporaries of the problematic and inherently political nature of representation and interpretation.[5] "Each thing, each thing implies or represents," writes Donne in "Satire V" (late 1590s).[6] The political controversy over representation stems, for Donne, from original sin; in a postlapsarian world, nothing is self-evident. The poems read like rhetorical battlefields on which the speaker attempts to draw competing accounts into question, casting doubt on alternative representations of the world, moral action, and self. The exhortation in "Satire III" (1596) to "Doubt Wisely" is an admission of the poet's suspicion of authority and an acknowledgement of the mystery, inexhaustibility, and inescapability of metaphor, which Donne's poetry—characterized by paradox, wit, and irony—embodies. "Doubt Wisely" is also a methodological imperative which, in Donne's estimation, must inform a Protestant theology of language; it is an argument for the endless construction and deconstruction of both text and self in the impossible—but necessary—quest for the divine on earth.[7]

The postlapsarian chaos which the "Anniversaries" depict reflects, in one sense, seventeenth-century contentions over the nature of the physical world and over scriptural interpretation, suggesting the extent to which the former is implicated in the latter. Donne's description in the *Essays in Divinity* (1614) of the fracturing of the Biblical text in the hands of disputatious theologians mirrors the physical chaos depicted in the "Anniversaries": "So do they demolish God's fairest Temple, his Word, which pick out such stones, and deface the integrity of it, so much as neither that which they take, nor that which they leave, is the world of God."[8] Donne sees language and, in the "Anniversaries," the natural world as media of representation that are subjected to a coercive misprision by individuals who construct God's will to justify their own morally and politically suspect ends. In this respect, the hyperbolic rhetoric which frames the introduction of the problem posed by the New Philosophy, at line 205, nearly halfway through the First Anniversary, is a sardonic dismissal of its centrality in the larger debate over interpretation.

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[4] See, for example, the essays collected in George Levine, ed., *One Culture: Essays in Science and Literature* (Madison: Univ. of Wisconsin Press, 1987); and Joseph Rouse, *Knowledge and Power: Toward a Political Philosophy of Science* (Ithaca: Cornell Univ. Press, 1987).

[5] On the self-conscious use of form in the Renaissance, see Stephen Greenblatt, *Renaissance Self-Fashioning: From More to Shakespeare* (Chicago: Univ. of Chicago Press, 1986); and Greenblatt, ed., *The Power of Forms in the English Renaissance* (Norman: Pilgrim Books, 1982).

[6] All dates provided are from R. C. Bald, *John Donne, A Life* (New York: Oxford Univ. Press, 1970).

[7] Augustine observes: "Have we spoken or announced anything worthy of God? Rather I feel that I have done nothing but wish to speak: If I have spoken, I have not said what I wished to say. Whence do I know this, except because God is ineffable? . . . For God, although nothing worthy may be spoken of Him, has accepted the tribute of the human voice and wished us to take joy in praising Him with our words" (*On Christian Doctrine*, ed. D. W. Robertson, Jr. [Indianapolis: Bobbs-Merrill, 1958] 10-11).

[8] John Donne, *Essays in Divinity*, ed. Evelyn M. Simpson (Oxford: Oxford Univ. Press, 1952) 40-41. Future references to the *Essays* will be noted as *EID* and cited parenthetically.

And new philosophy calls all in doubt,
The element of fire is quite put out;
The sun is lost, and th'earth, and no man's
    wit
Can well direct him where to look for it.[9]

The passage is also a riddling allusion to the project of the poem itself, the embodiment of an interpretive process. Donne is, in fact, the "wit" who would tell us where to look for the interpretive center, the new "element of fire" to replace the ones so easily snuffed out. These lines acknowledge the limitation of any single human interpretation in the face of divine mystery and make ignorance an article of faith. As Charles Coffin suggests, for Donne the doubt born of competing interpretations of both nature and scripture ironically becomes a vehicle for religion founded on faith (181).

For Donne, the Copernican and Ptolemaic universes are not unproblematic reflections of divine truth but metaphors which serve particular moral and theological ends. Originally appropriated by Aquinas as a metaphor for divine perfection, the Ptolemaic universe was literalized and used by the Church to buttress orthodox theology. The threat Copernicanism poses to the Church and to the idea of a divinely ordained order is, therefore, for Donne, an indictment of the faithlessness of the proponents of the Ptolemaic universe. At the same time, however, the apostles of Copernicanism replicate scholastic argument by dogmatically inscribing their own order upon the heavens. Like the proponents of the Ptolemaic universe, those of Copernicanism continued to locate theological certainty in the structure of the heavens. In effect, the radicalism of sixteenth-century scientists like Kepler lay in having outstripped the Church in assimilating their observations to Catholic theology.[10] In a letter to Goodyer in 1609, Donne acknowledges that the Copernican universe can be recuperated for orthodox theology; as a metaphor for man's subordination to God, Donne suggests, the Copernican universe is "'thus appliable well.'"[11] In *Ignatius His Conclave* (1611), Ignatius argues that the Copernican model is not sufficiently original or radical enough to gain Copernicus entry into Hell; it will not assist Ignatius' "master" Satan in the acquisition of souls:

What cares hee whether the earth travell, or stand still? Hath your raising up of earth into heaven brought men to that confidence, that they build new towers and threaten God again? Or do they out of this motion of the earth conclude, that there is no hell, or deny the punishment of sin? Do not men believe? Do not they live as they did before?[12]

Ignatius' position approximates Donne's own. Both suggest that the relationship between earth and sun is, in and of itself, of no particular significance. What is significant, however, is the tenor that is assigned to the vehicle which each model—or metaphor—constitutes and the motives which underlie a given construction.[13] The irony in this passage offers an acerbic commentary on the sinfulness and inconstancy of man and his continual attempts to identify his

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[10]Kepler was drawn to Copernicanism by theological concerns and saw the heliocentric universe as evidence of God's omnipotence. He also argued that the heliocentric universe provided confirmation of the Trinity:

The number THREE is represented in the sphere by the the centre, the content; in the stationary world by the fixed stars, the sun and the ether; in the divine Trinity by the Father, the Son and the Holy Ghost. As the Sun dwells in the midst of the planets, at rest, yet the source of motion, he is the image of God the Father, the Creator. The relations of God to his creation is that of the Sun to motion; and as the Father is the creator in the Trinity, so the Sun is the source of motion among the stars.

(cited in Nicolson 152)

Thomas Digges, "the first Copernican to replace his master's conception, that of a closed world, [with] an open one" described the new, infinite universe as the "Court of the great God, the habitacle of the elect, and the coelestial angelles" (cited in Alexander Koyre, *From the Closed World to the Infinite Universe* [Baltimore: Johns Hopkins Univ. Press, 1957] 36). Like a somewhat less chaotic version of contemporary chaos theory, the new cosmology reflected an ordered chaos. Although the underlying unity of the Copernican universe, like that of the Ptolemaic model, lay in the way it reflected man's relationship to God, it was not a static model of ordered perfection, but of man's subordination to God, of postlapsarian chaos. In the twentieth century, as Docherty's argument illustrates, the Copernican universe has come to represent the absence of God.

[11]Cited in Carey 249.

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[9]Frank Manley, ed., *John Donne: The Anniversaries* (Baltimore: Johns Hopkins Univ. Press, 1963) FA: 205-8.

[12]John Donne, *Ignatius His Conclave*, ed. Timothy Healy (Oxford: Oxford Univ. Press, 1969) 17.

authority with God's. The New Philosophy is simply the latest of the many towers men have built throughout history to threaten God.

In the "Anniversaries," Donne's indictment of the human presumptiveness of the proponents of the Copernican and Ptolemaic universes reflects and extends the poet's critique of the goals of experimental philosophy and technology. The goals of experimentalism, articulated by Francis Bacon, reflect the protestant belief, shared by Donne, in the "fallenness" of nature and language. For Donne, the imperfection of nature and language serves, paradoxically, as "proof" of man's dependence upon the voluntary infusion of divine grace in the world. Bacon, in contrast, insists upon man's capacity to restore both through his own agency.[14] A brief comparison of Donne's and Bacon's respective attitudes toward nature and language is necessary for understanding the timeliness of Donne's concerns for contemporary readers, and the critical, ideological, and environmental consequences of the triumph of the Baconian perspective, through which Donne's "Anniversaries" traditionally have been read.

Like the astronomers of the sixteenth and seventeenth centuries—and indeed like Newton and Boyle after the Restoration—Bacon frames the goals of his project in theological terms. The goal of elucidating the divine order in nature is implicit in Bacon's quest for the "summary law of nature."[15] The project of experimentalism, which "takes off the mask and veil from natural objects" (*Aphorisms* V), is to provide authoritative readings of the Book of Nature, eliminating the space for idiosyncratic interpretation implicit in the doctrine of the "inner light." Bacon distinguishes experimentalism, with its emphases on the objective observation and technological manipulation of nature, from scholasticism and other rhetorical constructs and doctrines which are no more than "dogmas and figments of the wit" (*Preparative Toward a Natural and Experimental History*, introduction). Despite Bacon's claim to objectivity, his project is unmistakably evaluative. The "importance" of the particular objects of study—the elements of the natural world—is not "measured by what they are worth in themselves, but according to their indirect bearing upon other things, and the influence they may have upon philosophy" (*Aphorisms* VI). Experimentalism, as a branch of philosophy, is inseparable from the sphere of human action: "For it is works we are in pursuit of not speculations" (*Aphorisms* VII). The selection of the objects of study, and the ends to which the knowledge gained from them is applied, are guided by the social—and political—intentions of the experimentalists.

Implicit in experimentalism, in fact, are the paradoxical goals of both representing divine order in the world and redeeming chaotic, postlapsarian nature.[16] We find in Bacon's division of nature into "species of things," "monsters," and "things" artificial a rhetorical tradition in science that is inherently evaluative rather than experimentally derived, reflecting a Calvinist suspicion of nature as "other":

> Nature exists in three states, and is subject as it were to three kinds of regimen. Either she is free, and develops herself in her own course; or she is forced out of her proper state by the perverseness and insubordination of matter and the violence of impediments; or she is constrained and moulded by art and human ministry . . . in things artificial nature takes order from man and works under his authority: without man, such things would never have been made. But by the help and ministry of man a new face of bodied, another universe or theatre of things, comes into view.
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> (*Aphorisms* I)

The base materiality of nature, constructed in

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[13]Carey states that Donne "did not care whether the new theories were true or not, as long as they supplied material for his speculation. . . . They were grist to his mill, whether he denounced them or used them for images" (250). This position, however, seems somewhat inconsistent with Carey's assertion that, for Donne, "How things are is known only to God" (246). Carey also finds Donne's approach to Copernicanism in *Ignatius His Conclave* inconsistent with the one reflected in the "First Anniversary."

[14]See Achsah Guibbory, *The Map of Time, Seventeenth-Century English Literature and Ideas of Pattern in History* (Chicago: Univ. of Illinois Press, 1986) 43-63.

[15]*Great Instauration*, vol. 4 of James Spedding, Robert L. Ellis, and Douglas D. Heath, eds., *The Works of Francis Bacon*, 15 vols. (Boston: Houghton Mifflin, 1861) 31. Unless otherwise noted, Bacon citations are from this edition.

[16]My discussion of Baconianism as reflecting these paradoxical goals is indebted to Robert Markley's discussion of Newton and Boyle in "Objectivity as Ideology" (355-72).

this passage as female, is invoked to justify the goal of experimentalism, the appropriation of nature by technology.[17] Redemption and exploitation are, in fact, one and the same.

Donne's poetic method in the "Anniversaries" counters the experimentalists' theological justifications for dominating nature and asserts the interpretive heterogeneity of radical protestantism against the totalizing claims of both scholasticism and natural philosophy. The multiple meanings with which Donne infuses both the Ptolemaic and Copernican models, like the multiple characters which "She," the subject of the poem, embodies, serve as a commentary on the necessary flexibility of interpreting metaphor in both language and nature in the aftermath of the Reformation. The chaos of the "sick world" is reflected in its inability to define itself precisely in the absence of "She," the missing subject:

> Her name defin'd thee gaue thee forme and
>   frame,
> And thou forgetst to celebrate thy name.
> Some moneths she hath beene dead (but
>   being dead,
> Measures of time are all determined)
> But long shee'ath beene away, long, long,
>   yet none
> Offers to tell us who it is that's gone.
>   (FA: 37-42)

The subject of the poem defies reduction to a single literal entity. Elizabeth Drury serves only as a point from which others, including Elizabeth I, Astraea, as Marjorie Hope Nicolson has persuasively argued, and the Virgin Mary radiate in concentric circles, bounded at the outermost circumference by the Logos.[18] "She," therefore, does not exist as a static symbol but serves a mediating function, uniting the discrete mortal—and immortal—characters in relationship to the Logos. Donne's explicit references to

his subjects as "types" of a larger principle of unity foreground his project of establishing an authoritative means to interpret otherwise fragmented texts or discourses:

> Shee, who if those great Doctors Truely said
> That th'Arke to mans proportions was
>   made,
> Had beene a type for that, as that might be
> A type of her in this, that contrary
> Both Elements, and Passions liued at peace
> In her, who caus'd all Ciuill warre to cease.
>   (FA: 317-22)

The flexibility of the subject, "She"—in this passage embodied as Queen Elizabeth—demands that the interpretive principle of "multiplex intelligentia," articulated by Aquinas, be employed to render the poem, as a microcosm of the world, coherent.[19] The world, like the subjects of the poem, cannot be construed as a collection of discrete entities. Rather, everything is united in relation to the Logos, in which the essence of all that is resides. "Shee who all Libraries had throughly red" (SA: 303) is both ideal reader, and the Logos itself, "our best and worthiest booke" (SA: 320). "She" is not simply the object of interpretation; she also exemplifies a hermeneutical process in which the hope of returning coherence to a fragmented world resides.

As a meditation on prelapsarian unity and a reflection of Donne's obsession with origins, the poem marks a fundamental area of disagreement between Bacon and Donne. Though Bacon believes that "throughout history philosophers have reenacted the Fall by looking inside their own minds rather than by observing and studying nature as she truly is" (Guibbory 47), he contends that experimentalism is the corrective through which "endless progress" toward a true knowledge of God becomes possible.[20] In contrast, for Donne, human knowledge is not progressive; history consists of

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[17]Coffin briefly acknowledges that Donne's critique of natural philosophy in the "Anniversaries" reflects the poet's suspicion of the Baconian impulse toward "the control and domination of the natural world" (181). On the gendering—and suppression—of nature, see Nancy Leys Stepan, "Race and Gender: The Role of Analogy in Science," *Isis* 77 (1986): 261-77; Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale Univ. Press, 1985), esp. 33-43; Carolyn Merchant, *The Death of Nature* (New York: Harper and Row, 1980), esp. 1-41 and 164-90.

[18]See Nicolson 92-96.

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[19]According to the principle of "multiplex intelligentsia," the layers of meaning which the Bible contains reflect the multiple meanings of everything in existence. Interpretations, Aquinas states, "'are not multiplied because one word signifies several things, but because the things signified by the words can themselves be types of other things.'" See Charles Feidelson, *Symbolism and American Literature* (New Haven: Yale Univ. Press, 1952) 88. Applied to the natural world, this principle suggests that the elements of nature, like scriptural passages, are not reducible to a singular "meaning" or definition.

a succession of falls which result from man's arrogance. Man comes closest to God when he is reflecting on his limitations, on his fallenness. Simply invoking the metaphor and the memory of original prelapsarian unity serves, for Donne, a redemptive function.[21] Though redemption is ultimately other-worldly and contingent on God's grace, man can strive to be worthy of grace by the internal exercises of self-examination and contemplation, which in turn lead to moral action.

The simultaneous absence and presence of the poem's subject reflects Donne's ambivalence toward nature and language as well as his attempts to preserve the voluntarism of God as he explores them poetically:

> Though shee which did inanimate and fill
> The world, be gone, yet in this last long
> night,
> Her ghost doth walke; that is, a glimmering
> light,
> A faint weake loue of vertue and of good
> Reflects from her.
>
> (FA: 68-72)

"She," as the dead girl—as order, virtue, and Logos—is only a "trace" in the poem, as in the world and in language. Donne does not identify the Logos absolutely with either nature or language, but preserves the possibility of meaning in both realms. By making absence the occasion of the poem, Donne paradoxically accords absence a redemptive function, completing or perfecting imperfect nature.

As a symbol of the experience of the relationship of God to the natural world, the shadowy nature of "She" reflects Donne's answer to Bacon's argument for the rehabilitation of nature. Because "She" is both a virgin and dead, and thus twice removed from the realm of depraved nature, Donne can safely reflect that in "her" lifetime, "She" was privy to the unmediated perception of God in nature. As an embodiment of the "ideal reader" of the Book of Nature, morally unassailable and "elect," "She" becomes a medium of and symbol for the redemption of the postlapsarian physical world.

In her eyes, and through the voluntary visitation of the Logos on earth, nature is redeemed:

> Shee, who had Here so much essentiall ioye,
> As no chance could distract, much lesse
> destroy;
> Who with Gods presence was acquainted
> so,
> (Hearing, and speaking to him) as to know
> His face, in any naturall Stone or Tree,
> Better than when in Images they bee.
>
> (SA: 449-54)

"She" is characterized by contemplative vision, unadulterated by a desire for control. The Dean of St. Paul's is moved to denounce those whom he calls the "Anatomists of words," who, in imposing a narrow literalism on scripture, attempt to construct God: "He which . . . asks, Why Gods will was so, inquires for something above God. For, find me something that enclines God, and I will worship that" (*EID* 48). In contrast to the "Anatomists of words," who seek to impose human conceptions of meaning on the Logos, "her" vision is unifying, humble, and passive; it is akin to worship.

The simultaneous absence and presence of the subject as "Logos" serves, within the realm of linguistic representation, parallel functions to those I have discussed with respect to nature. Donne conceives of language as originally Adamic, reflective of the true nature of things in the world, though it has, over time, been corrupted by the Fall and by misuse. He is given to questing after Adamic clarity in his persistent concern with etymology and in his belief that "'To know the nature of the thing, look we to the derivation, the extraction, the Origination of the word.'"[22] His emphasis on origins reveals the impulse Donne shares with his contemporaries that informs the project of natural philosophy: to deny the agency of the human interpreter in order to maintain the possibility of an authoritative system of representation which embodies uncontestable meaning. For Donne, however, the pristine Adamic language remains an ideal which, paradoxically, must be sought but which cannot be realized on earth. Fallen language is a function of man's fallen moral state: because nature cannot be rehabilitated neither can language.

The complement to Donne's quest to return to etymological origins—and his acknowledge-

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[20]*The Advancement of Learning and the New Atlantis*, ed. Thomas Case (London: Oxford Univ. Press, 1974) 11.

[21]See Guibbory's discussion of "Memory as Remedy" 88-96.

[22]Cited in Guibbory 83.

ment of the impossibility of achieving Adamic clarity in a postlapsarian world—is his paradoxical inclination to attribute a redemptive function to the fallenness of language and, by implication, to nature as well. Donne perceives human speech as evidence of man's inferiority to God, who "will be glorified both in our searching these Mysteries, because it testifies our liveliness towards him, and in our not finding them" (*EID* 49). The argument for the voluntarism of God allows Donne simultaneously to acknowledge the limitations of language and to preserve the possibility of meaning. The Logos bridges the schism between sign and signified, but unmediated perception of the Logos is predicated on both moral purity and election, and the latter can never be assured during one's existence on earth. One can gain some knowledge by studying etymology, but Adamic clarity is finally unattainable. Therefore, in the "Second Anniversary," "She," as a virtuous mortal, is characterized by "Her ignorance in this life and knowledge in the next" (SA: section title).

Donne's position can be defined in contrast to Baconian assumptions about language that effectively deny the voluntaristic nature of the relationship of the Logos to fallen speech. Bacon equivocates between accepting the conception of the "signifier" as originally "revealing" the essence of the signified and a conception of signified and signifier arbitrarily fixed by God but nonetheless reflecting the true nature of reality.[23] He does not waver, however, in his belief that an "ideal language" which would restore Adamic clarity "does not depend on an intrinsic relationship between its words and referents, but instead would establish a fixed but arbitrary connection between words and the mind's correct understanding of nature" (Elsky 454-55). This connection would be realized by careful study of the natural world. The quest for linguistic transparency informs his imperative of rhetorical simplicity, which he equates with the objective investigation of the physical world. Bacon's influence, in this regard, is evident in the aesthetic of rhetorical simplicity promoted by the Royal Society in the 1660s. Thomas Sprat, Joseph Glanvill, and others foster the fiction that "science" and language can transcend the metaphorical, which they equate with the

related dangers of the individual imagination and political corruption.[24]

Bacon's belief in the progressive knowledge of the natural world as a means to restore Adamic clarity, and implicitly to effect the redemption of nature, would strike Donne as an attempt to seize God's prerogative. In the "Second Anniversary," the separation of the soul from the body is expressly equated with liberation: "death hath now enfranchised thee, / Thou hast thy expansion now, and liberty" (179-80). Death is liberating not simply for the mortal subject but for the Logos or world soul; it restores a proper balance between man and God and preserves the voluntarism of God, who cannot be literalized in either scripture or nature. As the Logos, the subject of Donne's eulogy is associated with "beauty" and "color" because, while they are evident to man through the senses, they are "incorporeal," not quantifiable or subject to control, and they "voluntary grew" (FA: 362). The generosity of God and the passive adulation of the dead virgin are contrasted to the arrogant desire for control that consumes man and is identified with the limitations of the five senses.

The project of both the old and new philosophies is, in Donne's estimation, a quest to control God by subjecting "Him" to the evidence of the senses in conjunction with reason. In the "Second Anniversary," Donne draws an analogy between studying the elements of nature and the reductive literalism which has come to characterize the contention over scriptural interpretation. The world is itself in several places expressly equated with a text, which the poet dissects to illustrate the effects of the old and new philosophies and of a parallel linguistic reduction:

> The body will not last out to haue read
> On every part, and therefore men direct
> Their speech to parts, that are of most effect;
> So the worlds carcasse would not last, if I
> Were punctuall in this Anatomy.
>
> (FA: 436-40)

[23]Martin Elsky, "Bacon's Hieroglyphics and the Separation of Words and Things," *Philological Quarterly* 63 (1984): 449-60.

[24]On the Royal Society's attack on metaphor and their equation of rhetorical simplicity with linguistic transparency and objectivity, see Brian Vickers, "The Royal Society and English Prose Style: A Reassessment," *Rhetoric and the Pursuit of Truth: Language Change in the Seventeenth and Eighteenth Centuries* (Los Angeles: Clark Library, 1985), esp. 3-63; Ralph W. V. Elliot, "Isaac Newton's 'Of an Universall Language,'" *Modern Language Review* 52 (1957): 1-18; and Markley, "Objectivity as Ideology" 355-57.

If nature is God's text, the old and new philosophers alike are fixated with its letter rather than its spirit. Both attempt to find out the whole through dissecting the parts, and in the process reproduce only the chaos of postlapsarian creation, not an image or understanding of divine order.

By making God's perfection and social order contingent on belief in a particular model of the physical world, the scholastics created the condition for the social, physical, and theological chaos which the new astronomy portends. The Ptolemaic model is, for Donne, the first tower of Babel, Copernicanism the second, and both are designed to usurp God's authority:

> They who did labour Babels tower t'erect,
> Might haue considerd, that for that effect,
> All this whole solid Earth could not allow
> Nor furnish forth Materials enow;
> And that this Center, to raise such a place
> Was far too little, to haue beene the Base;
> No more affoords this world, foundatione
> To erect true ioye, were all the meanes in
>   one.
> But as the Heathen made them seuerall
>   gods,
> Of all Gods Benefits, and all his Rods,
> (For as the Wine, and Corne, and Onions are
> Gods vnto them, so Agues bee, and war)
> And as by changing that whole precious
>   Gold
> To such small copper coynes, they lost the
>   old,
> And lost their onely God who euer must
> Be sought alone, and not in such a thrust.
>   (SA: 417-32)

In this passage, the earth is the implied "Center" of the universe, the measure of human perfection and experience. Yet paradoxically, Donne suggests, it is sheer arrogance to uphold it as the absolute center of the universe or to presume on the accuracy of limited human perspective. To the extent that both the Ptolemaic and Copernican models are constructed of the "materials" of the senses, out of the "evidence" which man gathers from the physical world, the Ptolemaic model serves ironically as a metaphor for the Copernican universe and the New Philosophy; both systems disrupt the relationship between God and man.

Donne seems also to suggest in this passage that the tendency to literalize either the

Ptolemaic or Copernican models is a form of paganism; he may have in mind the pantheism of the stoics, who held that the "world is 'full of gods'" and "deif[ied] nature by depersonalizing the gods."[25] At the other extreme, however, Donne must have been concerned with the nominalist tendency to divorce the universal from the particulars of the world, thereby positing a radical schism between God and the natural world that paved the way for the emergence of scientific materialism, in the eighteenth century, by justifying the subjugation of nature. By emphasizing, in the spirit of Calvinism, the voluntary intervention of the Logos in the natural realm, Donne avoids either extreme, subverting the nominalist and Baconian arguments for rehabilitation. Both approaches are, in Donne's estimation, catalysts of the same reaction, a process of reverse alchemy in which the mystical vision of God in the world is shattered into mundane particulars.

Ironically, despite the pervasiveness of the rhetoric of natural depravity, or perhaps as a complex complement to it, Donne preserves the possibility that nature is, in fact, well-ordered, that it is the failure of human perception to penetrate God's mysterious order in nature which results in apparent chaos. In Donne's eulogy on the golden age of unflawed perception in the "First Anniversary," he suggests that, on one level, the failure to perceive order in the heavens is a failure of human perception, the result of the fall from grace. The passage is equally, however, a satire on human arrogance, and on man's dependence on the assurance proffered by the old philosophy and its nostalgia for order.

> When, if a slow-paced starre had stolne
>   away
> From the obseruers marking, he might stay
> Two or three hundred years to see't againe
> And then wake vp his obseruation plaine.
>   (117-20)

Never has man lived long enough, Donne suggests, to assure himself that the order, as viewed through the apparent chaos of Copernicanism, is in fact an absolute reflection of the workings of the universe. Man's mortality—his fall into sin and death—ensures

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[25]Amos Funkenstein, *Theology and the Scientific Imagination from the Middle Ages to the Seventeenth-Century* (Princeton: Princeton Univ. Press, 1986) 158.

the fallibility of his perceptions. Donne's critique of the senses includes, then, both the objects of natural philosophy's study and the instruments it uses:

> When wilt thou shake off this Pedantery,
> Of being taught by sense, and Fantasy?
> Thou look'st through spectacles; small
>   things seeme great,
> Below; But vp vnto the watch-towre get,
> And see all things despoyld of fallacies:
> Thou shalt not peepe through lattices of
>   eies,
> Nor heare through laberinths of eares, nor
>   learne
> By circuit, or collections to discerne,
> In heauen thou straight know'st all,
>   concerning it,
> And what concerns it not, shall straight
>   forget.
>
> (SA: 291-300)

The telescopic capacity of the lens, invoked to support the experimentalists' claim to objectivity, guarantees, for Donne, no more clarity than "lattices of eies." The new technology simply multiples the distortions and weaknesses of the senses. The objects it studies remain discrete particulars of an imperfect knowledge that must and will be forgotten when the soul ascends to heaven.

Ironically, in Donne's hands, the contention over the nature of the physical world, and the limitations of the technological tools constructed to dominate it, like the instability of language, inform his argument for the transcendence of God. In England, in the latter half of the seventeenth century, the clock came to connote determinacy and rigid order.[26] For Donne, as for voluntarists like Newton, the clock symbolizes human limitation. If man is puzzled by his own petty machinery, so much the less is he able to fathom the mysteries of God: "Alas, we scarse liue long enough to trie / Whether a new made clocke runne right, or lie" (FA: 129-30). The attempt to reduce God to a "new-made clock" which one can anatomize, understand, and control can only result in a scattering of parts. As a metaphor for an interpretive process, the clock, which does not seem to need interpreting—which promises perfect accuracy

but does not deliver on that promise—suggests the falsity of the experimental philosopher's claim to unmediated knowledge of the natural world. As a mechanical device, the clock symbolizes, moreover, the threat that the natural philosopher's claim to objectivity poses to interpretive freedom.

Donne's concern with preserving freedom in language is a frequent topic in the *Essays in Divinity*, in which it is explicitly tied to the freedom of God and implicitly to the freedom of the individual in the face of others' attempt to invoke God to justify their morally and politically suspect ends. By severing the absolute relationship between sign and referent, Donne attempts to infuse language, as a representation of the Logos, with the freedom which Calvin attributed to God. Donne's attempt to subvert the possibility of narrow literalism, and yet preserve the possibility of meaning, can resolve itself only in paradox, which Donne accepts as an appropriate expression of the mystery of God. God, he asserts in *Devotions Upon Emergent Occasions* (1623-24), is both "literall" and "figurative":

> My God, my God, thou art a direct God,
> may I not say a literall God, a God who
> wouldst bee understood literally, and
> according to the plaine sense of all that thou
> saiest? But thou art also . . . a figurative, a
> metaphoricall God too: A God in whose
> words there is such a height of figures,
> such peregrinations to fetch remote and
> precious metaphors . . . such things in thy
> words. . . .[27]

For Donne, God is, as Barbara Lewalski observes, a "poet" who plays in language and whose language is incarnate in nature.[28] "He" would not be construed narrowly, but is not without intentions, which may be accessible to the ideal reader, one who is not only pious but "elect," whose comprehension is unimpaired by the desire to be reading a story in which the reader is the central character. Donne's notion of the ideal reader is ironically akin to Bacon's idea

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[26]Otto Mayr, *Authority, Liberty & Automatic Machinery in Early Modern Europe* (Baltimore: The Johns Hopkins Univ. Press, 1986) 45.

[27]John Donne, *Devotions Upon Emergent Occasions*, ed. John Sparrow (London: Cambridge Univ. Press, 1923) 113.

[28]Barbara Kiefer Lewalski, *Donne's Anniversaries and the Poetry of Praise, The Creation of a Symbolic Mode* (Princeton: Princeton Univ. Press, 1973) 153.

of the disinterested experimentalist, the receptive *tabula rasa* on which nature imprints herself. For Donne, however, the expansiveness of metaphor and its capacity for embodying paradox is as important as the "meaning" it simultaneously conceals and reveals. Donne's attempts to yoke the literal and mystical find their way into the works of those natural philosophers, like Boyle, for whom the "mystery" of both scripture and nature takes precedence over literal interpretations.[29]

As a representation of the mystery and transcendence of God and, paradoxically, of both original unity and the limitations of human interpretation in the aftermath of the Fall, metaphor, with its capacity to embody multiple and conflicting interpretations, serves, for Donne, a socially redemptive function. To the Donne of 1611, living in a world fraught with sectarian squabbling, the flexibility and contingency of verse offers a promise of order or at least the potential for discerning and creating an imperfect intimation of divine perfection. Ironically, in the process of "anatomizing" chaos, the poet renders himself a type of Christ, retrieving man from chaos, rendering chaos intelligible in relation to the Biblical narrative. The poem becomes a type of the Logos, the narrative of chaos and redemption of which all subsequent narratives are types, the primordial ordering word from which the possibility of all meaning stems. The primordial narrative of the Bible is, in effect, a narrative about narrative, in which the metaphorical is (con)fused with the literal, the pseudo-literal deconstructed and reconstructed as a narrative about deconstruction and reconstruction *ad infinitum*. Man "by confidence growes weak" and is confronted with the failure of his perception, with chaos and revolution (FA: 86).

Donne's and Bacon's responses to the interpretive Babel in the aftermath of the Reformation are representative responses to the loss of an authoritative interpretation of the world. "Submission to an absolute power or authority situated outside the self" is, Greenblatt suggests, a necessary condition, in the Renaissance, for "self-fashioning," which is "achieved in relation to something perceived as alien, strange or hostile" (*Renaissance Self-Fashioning* 9). For Bacon, the creation of self is predicated on identifying with institutionalized authority and submersion in the redemptive projects of natural science, on subduing the otherness of nature.[30] Donne, in contrast, does not see order embodied absolutely in language or the natural world, or for that matter in a narrowly defined institutional authority. Rather, it lies in the interaction between the conscience of the individual and God, mediated by scripture and nature—in the responsible exercise of freedom. For Donne, like Calvin before him, endless self-scrutiny characterizes the human condition in the aftermath of the Fall and of the Reformation, of which Donne's apostasy was a type. In contrast to the implied reader of the "Second Anniversary"—"Thou art too narrow wretch to comprehend even thyself" (262)— "She" is "at home in her own thoughts" (SA: 304).

Donne's estimation of verse as having a "middle nature" is at once an acknowledgement of the centrality of the poet in both creating and elucidating order in the aftermath of the Reformation and of the limitations and mediation of the human interpreter (FA: 473). Poetry and interpretation are, for Donne, the paradigmatic Protestant acts of worship; they embody both the quest for unity and the impossibility of ever attaining it, of penetrating the veils of figuration that shroud the essential mystery of the literal God.□

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[29]Donne's conception of metaphor bears interesting parallels to Boyle's understanding of scripture as it informs his approach to the Book of Nature. Markley argues in "Boyle on Language" that, for Boyle, "language may constitute and not simply reflect, the reality it attempts to describe" (160). Despite Boyle's suspicion of the morally ambiguous ends which metaphor can serve as a rhetorical device, it serves a redemptive function as the constitutive element of both nature and scripture. For Boyle, "language . . . is both mundane *and* mystical. Like Jacob's ladder, it is a form of metaphysical representation that mediates between the actual and the ideal" (161).

[30]See John C. Briggs, *Francis Bacon and the Rhetoric of Nature* (Cambridge, Mass.: Harvard Univ. Press, 1989).

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Molly Anne Rothenberg

MIRABILIS EXCREMENTUM AND THE LOGIC OF ECOMACHIA: LESSONS FROM THE HISTORIOGRAPHY OF EIGHTEENTH-CENTURY SCIENCE

To borrow a line from Bette Davis, "What a dump!" Garbage spilling over the tops of mountains; sewage smothering our harbors; carbon compounds poisoning the biosphere; toxic waste draining into drinking water. The litany of the evils of pollution seems endless, and so do the arguments over culpability and the costs of cleanups, over whose information is more scientifically valid, and how "man" should relate to—and manage—"nature." The logic that generates these arguments—an ecomachia that rehearses the seemingly intractable conflict between "man" and "nature"—continually reproduces a simplistic and politically unproductive model of ecological thinking on the part of environmentalists and economic pragmatists alike.[1] Structured by a series of binary oppositions, this ecomachia idealizes and reifies nature as transhistorical, unitary, and autonomous in order to invoke an "objective" reality as an unassailable argumentative ground of fact. In the process, the logic of ecomachia mystifies or denies the recognition that human beings are irrevocably implicated in the construction of nature—biologically, materially, and conceptually. In this essay, I shall deal with some of the consequences of the reification of nature in eighteenth-century science to demonstrate that traditional representations of humankind's relationship to the environment perpetuate a binary—and politically sterile—logic which we in the twentieth century have not yet begun to understand.

The corpus of Western scientific writing since the eighteenth century privileges objective description even as it constitutes—by means of an endless series of idealizations and evasions—the fiction of an "objective" position from which to describe nature.[2] At the end of the century we find one of the first extended critiques of objectivity as ideology: in *The Book of Urizen* and in *Milton*—reactions to the *Principia*—Blake elaborates the consequences of Newton's repression of his own rhetorical and metaphysical motivations. As Stuart Peterfreund has demonstrated, Blake analyzes Newton's denial of his responsibility for creating the hypothesis of an inaccessible, centralized, authoritative God, a hypothesis on which Newton's physical description of the universe depends.[3] This denial, according to Blake, actually produces a "fallen" universe, a reified nature, and a humanity alienated from nature and from itself. Attributing to God a view of nature that is in fact his own construction, Newton erases himself in order to position God "invisible, at the center of a universe composed of very visible, very dead, atomistic matter" (Peterfreund 215). Newton therefore reverses what Blake sees as the actual relationship between physics and metaphysics. In the *Principia*, physics seems to precede metaphysics; Blake understands that the contrary is also true, and that the consequences of repressing that truth are dire.[4] Alienation from nature, as Blake tells us, is not a founding event, nor a function of a mythical or historical fall, but a construct to repress our implication in the production of the "natural" as an a priori and transhistorical

[2] See, for example, Paolo Rossi's *The Dark Abyss of Time* (Chicago: The Univ. of Chicago Press, 1984) for an elaboration of the anti-objectivist position.

[3] Stuart Peterfreund, "Argument as Art, Argument as Science," *Studies in Eighteenth-Century Culture* 10 (1981): 205-26.

ideological guarantee.

In Blake's terms, this elision of our own participation in the production of the "natural" leads us to "stonify" nature, which conveniently makes it available for exploitation. I would argue that nature, contrary to the logic of ecomachia, is *not* given but constructed by the discourses and material practices of literature, agriculture, mechanics, economics, and so forth. The logic of alienation that Blake demystifies dictates that precisely because we do not have access to "nature" as unmediated reality but only to historically contingent constructions of it, we have continued to revert to the unacknowledged fiction that nature is autonomous and transhistorical, even in the literature of ecology. As a result, nature— idealized as that which is without remainder or waste—is itself alienated from labor, specifically from the very labors of discourse and practice which produce it and continue to reproduce it *for us.*

Traditionally, scientific, economic, literary, and philosophical discourses about nature exempt it from the category of the produced. Both sides of the ecomachia debate—environmentalists and exploiters—see attempts to link the spheres of the human and the natural by production as interventions in the condition of alienation that is taken to be the originary ground—the material fact—of our relationship to nature. Since Bacon, these interventions in the originary condition of human alienation have been characterized as dominations and violations of a nature which is irrevocably "other." At the conclusion of *The Advancement of Learning*, Bacon asserts:

> For man, by the fall, lost at once his state of innocence, and his empire over creation, both of which can be partially recovered even in this life, the first by religion and faith, the second by the arts and sciences. For creation did not become entirely and utterly rebellious by the curse, but in consequence of the Divine decree, "in the sweat of thy brow shalt thou eat bread," she is compelled by our labors (not assuredly

by our disputes or magical ceremonies), at length, to afford mankind in some degree his bread, that is to say, to supply man's daily wants.[5]

The oppositional logic embedded in this gendered model of man's relationship to a feminized nature reappears in the conflict between those who believe that dominating nature leads to productive results and those who argue that the rape of nature spawns a dangerous or monstrous progeny—pollution. What underlies both sides in the contemporary debates about "proper" ecological action and "practical" production is a description of nature that is "scientifically" validated by appeals to an autonomous realm—Blake's Newtonian Hell— external to our strategies for constructing it. In this reification of nature, the conditions of humankind's alienation and the proliferation of binary oppositions—prelapsarian/postlapsarian nature, man/nature, man/woman, production/ pollution—endlessly recur.

The history of Western representations of nature shows that in order for nature to function as this illusory origin of the discourses that in fact constitute it, another category—the nonnatural, the polluting—must dialectically reinforce it. Pollution is always defined in opposition to production, but neither term is absolute. It is not difficult to deconstruct the category of pollution as a Derridean supplement, and an entire study could be devoted profitably to historicizing this deconstruction. What is important for my purposes, however, is that this deconstruction highlights the need for a dialogical model of nature as contingent, complex, and dynamic. This model is intended to expose the strategies and consequences of our production of the "natural" as well as call into question the notion of systems as integrated, self-sustaining wholes while it allows for a nondeterministic analytics.[6]

In what follows, I wish to demonstrate how the logic of ecomachia is duplicated in current historiography even when it attempts to sidestep the pitfalls of binary thinking by

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[4]Robert Markley's and Ken Knoespel's forthcoming *Newton and the Failure of Messianic Science: A Postdisciplinary Inquiry into the Discourses of Natural Philosophy* (Norman: Univ. of Oklahoma Press, 1991) indicates that Blake's Newton is itself a historically mediated construct: Newton's manuscripts articulate a different version of God's relation to the universe and to Newton than appears in the *Principia*.

[5]Francis Bacon, *The Advancement of Learning and Novum Organum*, rev. ed. (New York: The Willey Book Co., 1900) 470.

[6]For the significance of this analytics, see the essays collected in *Chaos and Order*, ed. N. Katherine Hayles (Chicago: The Univ. of Chicago Press, 1991).

appealing to "interdisciplinarity." To illustrate this problem, it is useful to take an example from eighteenth-century history of science because the key assumptions about the role of science and technology in representing the "natural" that follow from Bacon and Newton become institutionalized within the disciplinary structures of "Enlightenment" thought at this time. I have chosen to examine G. S. Rousseau's analyses of the relationship between eighteenth-century scientific thought and literary production to reveal its strategies for constructing a transhistorical nature, its appeals to an eternally valid domain of truth to legitimate science, and its bid to repress its own historical contingency.[7] My purpose is not to attack Rousseau but to demonstrate how even "interdisciplinary" thinking is inhabited by traces of the disciplinary, systematizing thinking that it ostensibly calls into question. Rousseau's essays on Smollett, in this regard, provide an object lesson in the fundamental ways that the apparently self-sufficient categories of "man" and "nature" must be reconceived in order to move beyond the binary logic of ecomachia. His articles demonstrate not only the difficulties of working productively within the logic of these oppositions but suggest also what is ultimately at stake in deconstructing them.

In a notorious passage from *Humphry Clinker*, Smollett satirizes Dr. Diederich Wessel Linden, a man familiar to Smollett for his contributions to a bizarre pamphlet war concerning the question of whether sulphur was the active curative principle in the spa waters. In this passage, Dr. Linden is replying to Matthew Bramble's complaint that the stench of the waters at Hot Well, Bristol, might actually cause harm to those seeking relief at the baths:

> [Linden] observed that stink, or stench, meant no more than a strong impression on the olfactory nerves, and might be applied to substances of the most opposite qualities; that, in the Dutch language, *stinken* signified the most agreeable perfume as well as the most fetid odor . . . that individuals differed *toto coelo* in their opinion of smells, which

indeed was altogether as arbitrary as the opinion of beauty; that the French were pleased with the putrid effluvia of animal food, and so were the Hottentots in Africa . . . strong presumptions in favor of what is generally called *stink*, as those nations are in a state of nature, undebauched by luxury, unseduced by whim and caprice; that he had reason to believe the stercoraceous flavor, condemned by prejudice as a stink was, in fact, most agreeable to the organs of smelling; for that every person who pretended to nauseate the smell of another's excretions, snuffed up his own with particular complacency; for the truth of which he appealed to all the ladies and gentlemen then present. . . . That he himself [the doctor], when he happened to be lowspirited, or fatigued with business, found immediate relief, and uncommon satisfaction, from hanging over the stale contents of a close stool, while his servant stirred it about under his nose.[8]

After leaving Hot Well for Bath, Bramble writes to his own doctor that these baths also stink. Bramble is convinced that the water is polluted by diseased bodies and effluvia and that, contrary to popular opinion, the stink is not caused by the presence of sulphur.

In glossing these passages, Rousseau emphasizes the importance of the sulphur controversy in the eighteenth century, when two camps divided on the issue of the curative powers of sulphur. The chemists, of whom Dr. Linden was an eminent representative, argued that the water in the spas was effective therapy because it contained sulphur, which also accounted for the smell of the waters. According to this group, taking the waters facilitated a chemical interaction between the sulphur in the water and the sulphur in the body, which caused evacuation. The other group, adherents of a Galenist or humorist position, argued that the spa waters were effective because the water itself, not the sulphur, caused evacuation, thus restoring the balance of the humors. It was important for the humorists to deny the presence of sulphur in these waters, so they attributed the rotten egg smell to the presence of "scum" (feces and detritus), which in itself, they contended, had no consequences for the efficacy

[7] G. S. Rousseau, *Tobias Smollett: Essays of Two Decades* (Edinburgh: T. & T. Clark, 1982). It is worth noting that the Rousseau essays discussed here were written during the sixties and seventies and do not accurately reflect Rousseau's current thinking. This fact, however, does not alter my argument.

[8] *Humphry Clinker* (New York: The Nottingham Society, 1920) 24-25. All Smollett citations are from this edition.

of the waters.[9]

One remarkable feature of this debate as Rousseau presents it is that the presence of excreta in the water does not cause any problems for either side: in fact, "evacuation" is the preferred result of the treatments. For the humorists in particular the presence of feces is necessary to bolster their argument because it alone accounts for the stink of the waters. For the chemists, feces are of negligible importance because they are composed of nothing more than "earth, salt, water, and air": as Linden put it,

> *filth* . . . was also a mistaken idea, inasmuch as objects so called were no other than certain modifications of matter, consisting of the same principles that enter into the composition of all created essences, whatever they may be. . . . That, for his own part, he had no more objection to drinking the dirtiest ditchwater, than he had to a glass of water from the Hot Well.[10]

Within Linden's universe, and that of the chemists, excrement belongs to nature; it is the result of evacuation, a natural curative process.

According to Rousseau, the sulphur controversy is both the explanation and cause of Smollett's satire of Linden. Using evidence from Smollett's pamphlets in the sulphur controversy as well as from *Humphry Clinker*, Rousseau concludes, despite some major pieces of conflicting evidence, that Smollett thought that the debate was unimportant but that he also believed "Linden was farther from the 'truth'" than the humorists (154). Rousseau reaches this conclusion first because "as Bramble continues, we discover remarks which probably reveal Smollett's ultimate position, an unchanging one" when Bramble notes that there is no sulphur or brimstone in evidence at the baths (153). Furthermore, Smollett's parody of Linden

is taken by Rousseau to indicate a lack of sympathy for Linden's "pro-sulphur attitude, his Germanic background, and his flaunting pedantry" (154). Yet, according to Rousseau, Smollett must have considered the debate "'much ado about nothing.' . . . As he observed the squabbles of these doctors . . . Smollett's skepticism, I venture to say, grew" (154). Rousseau's conclusions that Smollett considered the debate unimportant, that his parody of Linden shows he preferred the humorists to the chemists, and that Bramble's observations on the absence of sulphur indicate Smollett's affinity for the position of the humorists are all called into question, ironically, by Rousseau's own findings. Smollett participated in the sulphur controversy during the 50s and the 60s: a twenty-year interest in this debate could easily indicate that Smollett did not consider the issue "much ado about nothing." Furthermore, although Linden is a butt of Smollett's satire, so is Matthew Bramble, a hypochondriac who fancies he knows as much about disease as his doctor. More importantly, Smollett intervened in the debate against the humorists, as Rousseau himself notes (149).

The inconsistencies of Rousseau's position suggest that his articles misrepresent the significance of the sulphur controversy for Smollett. It is clear that Smollett's interest, as expressed in *Humphry Clinker*, has less to do with the efficacy of sulphur than with the effects of water polluted by human excrement, for it is not Linden's pro-sulphur attitude that Smollett emphasized but his fascination with the stercoraceous, the same fascination present in Bramble's revulsion. Like his predecessors on both sides of the sulphur debate, Rousseau chooses to downplay the byproduct his analysis cannot account for, but the excrement suppressed in his discussion continues to resurface in the waters of Smollett's novel. Rousseau's emphasis on the sulphur debate as the explanation and cause of Smollett's satire of Linden reproduces the same deficiencies we find in present day ecomachia. We see in Rousseau's characterization of Smollett's "unchanging position" the denial of the fundamental connections between production ("evacuation") and pollution ("effluvia"). Rousseau also represses the ways in which his rhetorical position constructs a transhistorical view of nature to which he resorts as the metaphysical guarantee of scientific validity. He accepts uncritically rather than interrogates the means

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[9]The entire controversy is complicated by the fact that two unrelated definitions of sulphur are at work: sulphur is taken to mean a principle of heat, which according to the chemists is responsible for the curative powers of the waters, and sulphur is also taken to mean the compound of brimstone, which accounts for the stench. Unless otherwise noted, all Rousseau citations are from *Tobias Smollett*, "Smollett and the Sulphur Controversy" 144-57.

[10](26). Ditches were commonly used as latrines, so the difference between ditch water and the water from Hot Well would be negligible.

by which science legitimates its claims to authority: as we shall see, legitimation is a crucial issue in Smollett's satire. In the process, Rousseau's failure to recognize that the relationship between Smollett's novel and eighteenth-century culture emerges within a complex, dynamic, and historically contingent discursive arena—which necessarily resists deterministic and totalizing descriptions of its processes—highlights the inadequacies of his "interdisciplinary" approach.

Rousseau's historical argument, then, depends upon his imposing post eighteenth–century conceptions of rationality and "scientific" skepticism on both Smollett and the sulphur controversy. Rousseau argues that Smollett sympathized with the humorist position because Bramble notes that there is no sulphur in the water. However, because Bramble stops taking the water, one might equally well argue that Smollett is endorsing the chemists' position that the waters would only be healthful if sulphur were present. Apart from the obvious fallacy of equating Smollett's position with that of one point of view in the novel (and one that is consistently satirized), Rousseau's appeal to Bramble's views fails to distinguish between the two sides of the debate. Bramble, unlike the chemists and the humorists, is disgusted by the pollution he encounters in his bathing and drinking water. His decision to stop taking the waters is partly determined by his sense that his is an anomalous case for which the waters may do as much harm as good, but mostly by his judgment that excrement in one's drinking water must be unhealthful. However, this scum that Bramble finds floating in the water at Bath seems to him excrementitious in the first instance *not* because it is the material excretion of other humans but because those other humans taking the waters with Bramble come from all social classes. The mingling of the classes produces scum—and feces in the water is the vehicle of that metaphor.

Before we read about the polluted waters, we learn that Bramble is repelled by all of Bath because its populace, like its architecture, is monstrously heterogeneous, a polluting of the proper orders of society caused by excessive *production*:

All these absurdities arise from the general tide of luxury, which hath overspread the nation, and swept away all, even the very dregs of the people. Every upstart of fortune, harnessed in the trappings of the mode, presents himself at Bath, as in the very focus of observation. Clerks and factors from the East Indies, loaded with the spoil of plundered provinces; planters, negro-drivers, and hucksters, from our American plantations, enriched they know not how; agents, commissaires, and contractors . . . usurers, brokers, and jobbers of every kind; men of low birth, and no breeding, have found themselves suddenly translated into a state of affluence, unknown to former ages. . . . Knowing no other criterion of greatness, but the ostentation of wealth, they discharge their affluence without taste or conduct, through every channel of the most absurd extravagance; and all of them hurry to Bath, because here, without any farther qualification, they can mingle with the princes and nobles of the land.

(55)

The "discharge of affluence through every channel" pollutes the social waters, all of which lead to Bath, where the commingling of the classes due to excessive production causes a political and a corporeal immersion in scum. "Luxury" and "extravagance" are figured as forms of pollution. Affluence is effluence, the excrement that raises Bramble's ire and turns his stomach.

Bramble's objections to Linden result (in part) from a similar repugnance for the heterogeneous: "[Linden] has read a great deal, but without method or judgement, and digested nothing. He believes everything he has read, especially if it has anything of the marvelous in it; and his conversation is a surprising hotch-potch of erudition and extravagance" (34-35). Not only does Linden represent a conceptual pollution, mingling erudition with extravagance, but he has read everything and digested nothing: his productions can as easily be the undifferentiated discharges of effluvia as they can be instructive, methodical, orderly discourse. Linden, then, functions in the novel as a specific instance of the general equation of affluence as undifferentiated "ostentation."

More importantly, we find in Bramble's linking of undifferentiation with ostentation—figuring both as excrement, as pollution—a reworking of the problem of legitimation that had troubled the scientific community since the inception of the Royal Society. By calling

attention to Dr. Linden's tendency to consider the "marvelous" as scientifically authoritative, Bramble marks the limits of his claims to represent a rational, scientific mentality. As Jan Golinski has explained in his recent work on phosphorus and the public cultures of science, one of the major problems in legitimating eighteenth-century science as a public discourse was precisely how to create material and discursive forms of credibility that did not derive from ancient authority.[11] Both Golinski and Steven Shapin have shown that the Royal Society relied on public performances to demonstrate successful experiments and to disseminate scientific knowledge.[12] These shows were presented to suitably genteel witnesses whose social status legitimated the results as socially and scientifically credible "facts." In order to attract these witnesses, scientists had to display marvelous spectacles: they literally had to sell tickets to their performances, but if the witnesses were persuaded by the marvels presented rather than by appeals to their reason, the performers risked being relegated to the status of mountebanks. By the same token, if the audience for these spectacles was not itself legitimate—if it consisted of a mixture of classes—it could not serve the function of legitimation.[13] The instability of categories like production/pollution or demonstration/ostentation or the marvelous/the irrational raises the difficulty of conferring value on certain explanations at the expense of others. Like Linden, would-be scientific authorities might be unmasked as mere purveyors of marvelous excrement rather than as rational explicators of the hitherto unknown.

The issue of legitimacy appears in a disguised form in Rousseau's discussion of Smollett. When Rousseau "suspects" that Smollett considered the sulphur debate ludicrous (despite the ample evidence of Smollett's continued interest in the debate) and when he "ventures to say" that

Smollett must have grown increasingly skeptical about the claims of both sides, he is attributing to Smollett the "rational scientific" perspective on the truth of the debate that results from twentieth-century standards of evaluation. Because Rousseau "knows" that neither side had a valid scientific claim, because he adjudicates the claims according to a standard of scientificity not present in the eighteenth century, he cannot believe that Smollett could have been "taken in." After all, Smollett himself satirized quacks of all descriptions in his novels. It does not occur to Rousseau that what is at stake in Smollett's satire are precisely the processes and forms of legitimation that are historically constituted because he is committed to two faulty ideas: first, that science uncovers the transhistorical truth of nature and, second, that the history of science is the history of increasingly accurate descriptions of nature. To depict a Smollett consistent with twentieth-century conceptions of science, Rousseau must reconfigure or ignore the problematic of legitimation and repress the metaphysical bases of his own construction of scientific rationality. His judgments depend upon an equation of scientific certitude and reality, a metadiscourse which lies beyond, and does not require, legitimation.

Furthermore, Rousseau has no model for interrogating the complex ideological arena which helped shape the institutionalization of science and the construction of historically contingent representations of nature in the eighteenth century. He wrote other articles which address the novel's relationship to science and politics, but, tellingly, although he uses the same information in these articles—for example, Smollett's insistent excoriation of the humorist Lucas in the sulphur debate—each essay constructs a different and incommensurable psychological motivation for Smollett. For example, in "Quackery and Charlatanry" Rousseau argues that Lucas is the type for the quack Ferret in *Sir Launcelot Greaves*, "a partisan, who wanted to fish in troubled waters; who having miscarried in his own country, endeavours to foment factions and disturbance in the city of *London*."[14] He suggests that Smollett would have objected to the humorist on the

[11]J. V. Golinski, "A Noble Spectacle: Phosphorus and the Public Cultures of Science in the Early Royal Society," *Isis* 80 (1989): 11-39.

[12]Steven Shapin, "The House of Experiment in Seventeenth-Century Science," *Isis* 79 (1988): 373-404.

[13]Cf. Steve Shapin and Simon Schaffer, *Leviathan and the Air-Pump* (Princeton: Princeton Univ. Press, 1985) for a discussion of the way in which this issue of social class underlies the debate between Boyle and Hobbes.

[14]Rousseau, "Quackery and Charlatanry in Some Eighteenth-Century Novels, Especially Smollett" (127), quoting Smollett's review of Lucas's *Appeal to the Commons and Citizens of London*, a review that appeared in the *Critical Review* 1: 169-70.

grounds of political disfavor and scientific charlatanry, a position reiterated by Rousseau in another essay, in which he claims that Smollett satirized Ferret for not appreciating "recent innovations in chemical terminology."[15] Hence, in the space of three articles, Rousseau contends that on the issue of the sulphur controversy Smollett preferred the chemists to the humorists on the grounds of more valid scientific learning and more palatable politics, preferred the humorists to the chemists on the grounds of Linden's German origin and "pedantry," and cared not at all for the sulphur controversy.

Thus despite his interdisciplinary interests, Rousseau is forced to contradict himself and to create a contradictory portrait of Smollett across these three essays because he subscribes to a totalizing and generalizing historiography of science. Simon Schaffer characterizes this "conventional historiographical picture of a free terrain in which a natural philosopher selects his position, his cosmology, and his form of expression of that cosmology according to *nature* or (as would be the anthropological version) according to biography . . . [as opposed to the archaeologists for whom] the terrain is constructed such that the enunciation of 'true' statements about nature, whether in matter-theory or in natural history, is produced and organized by specifically impersonal structures"—that is, by ideological, institutional, and socioeconomic imperatives.[16] If we judge by the articles in his volume *Tobias Smollett: Essays of Two Decades*, Rousseau believes that the individual is the ultimate locus of historical agency, and he implicitly accepts the truth value of science as well as the post-Kantian division of structures of knowledge into discrete domains, positions specifically rejected by the historiography that Schaffer advocates. His claims for Smollett in this volume are contradictory because for Rousseau the domains of science and politics monologically determine Smollett's concepts and positions.

This is an ironic outcome because Rousseau was responsible for bringing Schaffer's article to publication in the collection entitled *The Ferment of Knowledge* before he published his essays on

Smollett as a volume. It is doubly strange because Rousseau, who in the 1980s has made a career of interdisciplinary study, reproduces the disciplinary divisions on one level that he seeks to transgress on another. By contrast, in the same collection, Steven Shapin calls for historians of science to move beyond the intellectualist contextualism that we find so clearly represented in Rousseau's reading of Smollett. Shapin rejects the "illumination model" of science, which claims that

> individuals in an esoteric sub-culture generate scientific knowledge by contemplating nature and 'rationally' assessing their findings. The context wherein science is produced and judged is argued (or, more commonly, assumed) to be separable from other contexts. Yet, once science is generated and evaluated by individuals in the esoteric sub-culture, it may passively sift into the wider social and cultural context where its manifest truthfulness is a sufficient reason for its acceptance as an accurate account of natural reality.[17]

In its place, Shapin argues, we ought "to show scientific culture as a human enterprise situated in concrete historical contexts, and actively made and deployed by social groupings to serve a range of interests which cannot be specified in advance" (139). The approach Shapin calls for does not depend upon a transhistorical "nature" as its "factual" base, nor a progressivist version of the history of science, nor a liberal humanist recourse to individual biography as the enabling fictions of its bid for rhetorical authority. We might say that such an approach could transform Rousseau's argument by situating Smollett's texts within the complex discursive fields of later eighteenth-century natural philosophy, sentimentalism, politics, and socioeconomic ideologies, in effect promoting a postdisciplinary analytics of knowledge. In the process, this approach may change our evaluation of the effects of taking historical implication and ideological motivation into account.

However, as Rousseau's essays demonstrate, simply rejecting traditional historiography of science does not lead unproblematically to a cultural semiotics that escapes the reductive

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[15]Rousseau, "Smollett and Paracelsian Medicine" 158.

[16]Simon Schaffer, "Natural Philosophy," in *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science*, eds. G. S. Rousseau and Roy Porter (Cambridge: Cambridge Univ. Press, 1980) 90-91.

[17]Steven Shapin, "Social Uses of Science" in *The Ferment of Knowledge* 93-94.

logic of binary, oppositional (re)production. Since 1980, various constructivist accounts of eighteenth-century science and of contemporary scientific thinking have testified to the difficulty of finding an adequate conceptual model to interrogate the ways in which discourses interact. Constructivism tends to reproduce the assumptions and results of the oppositional logic which reinforces the ideology of alienation of humankind from nature; realist philosophers of science, for example, frequently charge constructivists with imposing their own "positivist," androcentric values on the material world.[18] While rejecting the realist assumptions which underlie such critiques, I would argue that it is crucial—conceptually and politically— to move beyond the binary models that structure and inform contemporary philosophy and history of science to articulate a dialogical approach. By "dialogical," I mean a move into an always and already contested realm of nature, into chaotic models of discourse and materiality which reject the teleological assumptions of progressivist accounts of knowledge.

By emphasizing a dialogical rather than an oppositional approach, I want to avoid privileging any one method of analysis or structure of thought: I am not arguing that I am in some absolute sense "right," or that I have some "correct" description of nature to offer, but that all descriptions, historically and theoretically, must be seen differentially, as the products and the producers of historically, politically, and socioeconomically engaged discourses. The conflicted ideological arena in

which ecomachia wages its battles, an arena of shifting political alliances, institutionalized representations, complex relations between culture and market, and competition for discursive authority, requires a theoretical perspective which acknowledges that the discourses, the very structures of knowledge— whether scientific, ecological, political, economic, or literary—by which we claim to understand, to represent, and to analyze nature, are themselves ideologically produced. As chaos theory and other nondeterministic analytics are making clear, the dynamic processes traditionally reified as "nature" frustrate attempts to analyze them as any one thing or as the product of any self-sufficient system. Nature is produced and reproduced locally and contingently, and if we are serious about confronting the ecological crisis of the twentieth and twenty-first centuries, we ought to be making it our business to trace the complexity of those forces of production. We need to describe our own strategies of disguised self-legitimation, strategies that mystify our responsibility for creating the material and conceptual mess we have made. We are paying, with the multiform life of the biosphere, for our insistence on simplicity, systematicity, and unitary order. It is time to turn our sewage into fertilizer, rethink the boundaries between pollution and production, and transmute the dangerous detritus of our post-Kantian intellectual habits.□

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[18]See, for example, Paisley Livingston, *Literary Knowledge* (Ithaca: Cornell Univ. Press, 1987).

Stuart Peterfreund

POWER TROPES: "THE TYGER" AS ENACTED CRITIQUE OF NEWTONIAN METONYMIC LOGIC AND NATURAL THEOLOGY

Without question, the single most striking rhetorical feature of Blake's "The Tyger," which first appeared in *Songs of Innocence and of Experience* (1794), is its questions—"thirteen unanswered questions, bound by the six hammered stanzas, [which] give the poem its peculiarly compressed verbal power," according to Stewart Crehan.[1] Numerous commentators have addressed the "tiger-questioner issue." For E. D. Hirsch and Roderick Huang, the questions posed by the speaker are essentially unanswerable.[2] For Morton D. Paley, the rhetoric of the poem and the speaker's questions are "sublime"—comparable to the questions asked in the Book of Job and therefore probably beyond the ken of human knowledge.[3] Paul Miner and Kathleen Raine both argue that Blake suggests or infers answers, while Larry Swingle wonders whether there is even a need to enter into conflict over the perplexities raised by these questions—whether, indeed, Blake was even mindful of such perplexities when he wrote the poem.[4] More recently, Crehan has argued that the questions underscore Blake's "response to the terrible, new-born beauty of violent

revolution" (125). And Harold Pagliaro has stated that the speaker's "questioning reveals an intense interest in an unclarified element of God's design. How can it be that the Creator of this world ordained hostility and death as the means of sustaining physical life at the same time he ordained love?"[5]

Perhaps Pagliaro's is the most apt of the preceding assessments of the ontological status of the poem's repetitive, even obsessive questioning. But neither he nor the others cited take account of the logical and rhetorical—more precisely, the figural—status of those questions. They are metonymic, attempting to mobilize the logic of *effectus pro causa* to reason back from the tiger as created effect to an understanding of his creative first cause. In their repetitions, the questions enact a critique of the Newtonian version of metonymic logic as well as of the applications of that logic by natural theology. Briefly summarized, the point of the critique is that the logic of the questions is circular, referring back to the cause of the questions—the speaker—rather than to the creative cause of the tiger. The long-term effect of the questions is to create the illusion that the speaker is empowered to speak in place of the tiger's creator by insisting on the tiger as a reified, naturalized effect of that first cause, and as a mechanism about which the speaker has some expert knowledge, when in fact the speaker has no such knowledge, mistakenly creating the tiger—and all of the delusory material universe, one might add—in his fallen image, not any version of God's. Another way of making this point is to say that figures such as metonymy do not hold open the possibility of transference, only the possibility of substitution.

To be sure, the speaker seeks to gain some sense of what "the Creator of the world" is like,

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[1] *Blake in Context* (Atlantic Highlands, N.J.: Humanities Press, 1984) 125.

[2] See *Innocence and Experience: An Introduction to Blake* (New Haven: Yale Univ. Press, 1964) 244; and "William Blake's 'Tyger': A Re-Interpretation," *Humanities Association Bulletin* 18 (1969): 31-33.

[3] See "The Tyger of Wrath," *PMLA* 81 (1966): 540-51; rpt. as "Tyger of Wrath," ch. 2 of *Energy and the Imagination: The Development of Blake's Thought* (Oxford: Clarendon, 1970) 30-60.

[4] See " 'The Tyger,' " *Criticism* 4 (1962): 59-73; "Who Made the Tyger?" *Encounter* 2 (1954): 44n; and "Answer to Blake's Tyger: A Matter of Reason or Choice?" *Concerning Poetry* 2 (1968): 61-71.

[5] *Selfhood and Redemption in Blake's Songs* (University Park, Pa.: The Pennsylvania State Univ. Press, 1987) 84.

but not by means of simile or metaphor. The latter of these may be, as Jonathan Culler argues, "the figure of figures, a figure for figurality," but it is not a figure employed by those aspiring to certain knowledge nor, more important, is it a figure used by those aspiring to empowerment through the attainment of certain knowledge.[6] Granted, metaphor comes into play tangentially in the implied comparison of the tiger's creator to an inspired (and implicitly divine) artisan who, with "immortal hand or eye, / Could frame thy fearful symmetry[?]"[7] But the point of the metaphor is to propose a metonymic relationship of effect-for-cause—a relationship, it should be added, that is reified and naturalized by the speaker's unremittingly repetitive questioning—in which the tiger-as-effect testifies to the existence of an artificer-as-cause that is the ultimate object of the speaker's knowledge.[8] The tiger, in other words, is the metonym for its creator (and all of his creation), the "literal term for one thing applied to another with which it has become closely associated," just as " 'Milton' " is the metonym for "the writings of Milton [and their author]."[9]

The same logic frames Book III of Newton's *Principia* (1687; 1729), his "System of the World." The axioms, or "Rules of Reasoning in Philosophy," that frame his discourse begin with an apparent statement of the law of parsimony, namely, that *"We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances."* The attribution of the causes of natural effects should save the phenomena while explaining them

satisfactorily, with the corollary implication that effects (or *"appearances"*) are metonyms of their causes. But what sort of effects—and, by extension, what sort of causes—are we talking about? Newton's second axiom—*"Therefore to the same natural effects we must, as far as possible, assign the same causes"*—offers the following as examples: "As to respiration in a man and in a beast; the descent of stones in *Europe* and in *America*; the light of our culinary fire and of the sun; the reflection of light in the earth, and in the planets."[10]

The cause of all of these effects as Newton understands them is God—specifically Elohim, the creator-God of the *P*-account of the creation (Gen. 1:1-2:4a).[11] He creates "the fish of the sea, and . . . the fowl of the air, and . . . every living thing that moveth upon the earth," as well as the man and women that "have dominion" over these (1:28) and, by implication, is the final cause of their respiration, markedly without the distinction of the ensoulment wrought by "the

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[6]*The Pursuit of Signs: Semiotics, Literature, Deconstruction* (Ithaca, N.Y.: Cornell Univ. Press, 1981) 189.

[7]*The Complete Poetry and Prose of William Blake*, rev. ed., ed. David V. Erdman, comm. Harold Bloom (Garden City: Anchor-Doubleday, 1982) 42.3-4. All further citations from Blake's works will be to this edition and will appear parenthetically in the text, by line, by plate and line, or by page, as appropriate. Joel Fineman, "The Structure of Allegorical Desire," in *Allegory and Representation*, ed. Stephen Greenblatt (Baltimore: The Johns Hopkins Univ. Press, 1981) 26-40, esp. 44, argues that "Every metaphor is always a little metonymic because in order to have metaphor there must be a structure, and where there is structure there is already nostalgia for the lost origin through which structure is thought. Every metaphor is a metonymy of its own origin, its structure thrust into time by its very structurality." In the case under consideration, the metaphor of creator as inspired artisan depends on the tacit acceptance of the metonymic relationship that sees the created universe as material effect of a divine first cause.

[8]Umberto Eco, *A Theory of Semiotics* (Bloomington, Ind.: Indiana Univ. Press, 1976) 281, insists, quite rightly, that one take metonymy on its own logical terms, as distinguished from those terms applicable to synecdoche. "Distinctions such as *pars pro toto, totum pro parte, genus pro specie, species pro genere*, etc. (concerning synecdoche) and *causa pro effecto, effectus pro causa, a possessore quod possidetur, inventas ab inventore, ab eo quod continet quod continetur*, etc. (concerning metonymy) seem to be rather important from a semantic point of view." Eco is virtually alone in insisting that metonymy be distinguished from synecdoche and that neither of these terms be treated merely as "weak" or "loose" variants of metaphor. For example, John R. Searle, *Expression and Meaning* (Cambridge: Cambridge Univ. Press, 1979) 108, offers an "account of metaphor" in which "it becomes a matter of terminology whether we want to construe metonymy and synecdoche as special cases of metaphor or as independent tropes." And Liselotte Gumpel, *Metaphor Reexamined: A Non-Aristotelian Perspective* (Bloomington, Ind.: Univ. of Indiana Press, 1984) 230, follows Quintilian's translator and commentator, John Selby Watson, in claiming "that synecdoche and metonym 'are not very different.' "

[9]M. H. Abrams, *A Glossary of Literary Terms*, 5th ed. (New York: Holt, Rinehart and Winston, 1988) 66.

[10]*Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World*, trans. Andrew Motte, rev. Florian Cajori (1934; rpt. Berkeley and Los Angeles: Univ. of California Press, 1966) 398.

[11]For a useful comparison of the *P*-account and the alternative *J*-account (Gen. 2:4b-2:25), see Robert Alter, *The Art of Biblical Narrative* (New York: Basic Books, 1981) 140-47.

breath of life" (*ruach*) in Adam in the *J*-account (2:7).[12] He creates the celestial bodies, earth among these, out of void formlessness (1:2), and imbues them with gravity.[13] The cause of light—by *fiat*, as it were—is God (1:3). So, too, is he the cause of reflected celestial light, at least as Newton reads the account of the "two great lights," the stars, and "the firmament of the heaven to give light upon the earth" (1:16-17), which make possible "the reflection of light in the earth, and in the planets."[14] Thus framed by a metonymic logic that attributes the *"causes of natural things"* to a divine first and final cause, no less fundamental a constituent of the Newtonian universe than corpuscular matter itself, the subject of the third of the "Rules" is attributable to that cause (*Mathematical Principles*

399). Newton does not say as much in the "Rules," but he does in the thirty-first query of the *Opticks* (1704; 1730). That "the least particles of all bodies [are] also all extended, and hard and impenetrable, and movable, and endowed with their proper inertia" is directly attributable to a God who "in the Beginning form'd Matter in solid, massy, hard, impenetrable, moveable particles . . . as most conduced to the End for which he form'd them. . . ."[15]

The addition of the notion of ends to that of causes suggests that the function of metonymic logic in Newtonian thought is justificational as well as explanatory, theological as well as scientific.[16] And indeed, it is metonymic logic that furnishes a basis for natural theology no less than for Newtonian science. For Newton's contemporary Robert Boyle, the Newtonian universe is, "as it were, a great piece of clockwork, [and] the naturalist, as such, is but a mechanician," or engineer charged with understanding the mechanism that is a metonym for its transcendent (and absconded) maker, appreciating its design, and celebrating the obvious skills of that maker.[17] So, too, for Blake's contemporary William Paley, writing in *Natural Theology* (1802): "This mechanism being observed . . . the inference, we think is inevitable, that the watch must have had a maker: that there must have existed, at some

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[12] In part because he rejects the Aristotelian notion of occult qualities as causes, in part because it has the potential to be subverted to trinitarian uses (such as arguments for consubstantiality) and in part because his antipathy to Cartesianism will not allow Newton to accept the distinction between ensouled humans possessing the cogito and animal automata lacking it, Newton marginalizes the whole question of ensoulment as a criterion of difference between animals and humans. There is no soul in his universe—no ghost in the machine. Rather, the machine is in the ghost, at least insofar as that ghost is synonymous with the "Lord God *Pantokrator*" Newton unveils in the "General Scholium" of the *Principia*. "In him are all things contained and moved," Newton says. Only at the very end of the "General Scholium" does Newton allude to "a certain most subtle spirit which pervades and lies hid in all gross bodies. . . ." But Newton begs off, stating that "these are things that cannot be explained in a few words, nor are we furnished with that sufficiency of experiments which is required to an accurate determination and demonstration of the laws by which this electric and elastic spirit operates" (*Mathematical Principles* 544-47).

[13] See *The Correspondence of Isaac Newton*, ed. H. W. Turnbull (Cambridge: Cambridge Univ. Press for the Royal Society, 1959-77) 1: 362-66, esp. 364. In the context of his "Hypothesis explaining the Properties of Light," first transmitted to Oldenburg for presentation to the Royal Society in the letter of 7 Dec. 1675, Newton proposes the existence of "an aethereall Medium much of the same constitution with air, but far rarer, subtiler & more strongly Elastic." This medium is conceived, like atmosphere air, as being compounded of "the maine flegmatic body of ether [and] partly of other various aethereall Spirits. . . . For the Electric & Magnetic effluvia and gravitating principle seem to argue such variety." The final cause of both this ethereal medium and the matter which it informs is God. "Perhaps the whole frame of nature [may be nothing but aether condensed by a fermental principle] . . . after condensation wrought into various formes, at first by the immediate hand of the Creator, & ever since by the power of Nature, wch by vertue of the command Increase & Multiply, became a complete Imitator of the copies sett her by the Protoplast."

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[14] In the letter of Jan. 1680/1 to Bishop Burnet, Newton discusses these verses. The latter concedes that, with specific reference to the relative size of the sun, moon, and earth versus their apparent size as viewed from the earth, and with specific reference to the notion of the "day" as cosmological unit, Moses "adapt[ed] a description of ye creation as handsomly as he could to ye sense & capacity of ye vulgar" rather than describing events as a natural philosopher might. Yet Newton insists that "the things signified by such figurative expressions are not Ideall or moral but true" (*Correspondence* 2: 331, 333).

[15] *Opticks, or a Treatise of the Reflections, Refractions, Inflections, and Colours of Light*, ed. H. D. Roller, based on the 4th ed., 1730 (New York: Dover, 1952) 400.

[16] Amos Funkenstein, *Theology and the Scientific Imagination from the Middle Ages to the Seventeeth Century* (Princeton: Princeton Univ. Press, 1986) 3-9, discusses science in the sixteenth and seventeenth centuries as constituting, in several senses, a "secular theology."

[17] *The Works of Robert Boyle*, 3rd ed., ed. Thomas Birch (London: T. and J. Rivington, 1772) 6: 724-25.

time . . . an artificer or artificers who formed it for the purpose which we find it actually to answer; who comprehended its construction and designed its use."[18]

Repeated with sufficient frequency, the metonym of the clockwork universe becomes reified as clockwork *tout court*, its creator as clockmaker (and winder), and the Newtonian scientist (and natural theologian) the person who speaks in the place (and name) of clockmaker and clockwork alike.[19] As such, that scientist and/or theologian operates on the assumption that he (and it is, most emphatically, *he*) has God's charter to utter pronouncements on a wide range of subjects, the civil and the social as well as the scientific and the theological, were such distinctions to be maintained as operative.[20]

As the title of this essay suggests, "The Tyger" is Blake's *enacted* critique of Newtonian metonymic logic and natural theology, but it is not his only critique. Before turning to consider the implications of the critique's enactment in "The Tyger," one ought to consider the most overt and perhaps earliest of Blake's critiques—the one found in *All Religions Are One* and *There is No Natural Religion* (1788), Blake's earliest engraved texts.

The critique is in evidence virtually from the first word of *All Religions Are One*. Its "Argument," or thesis, engages the issue of what the true nature of experiment and experience is, holding that "the true faculty of knowing must be the faculty which experiences" (p. 1). Aware that the reified clockwork universe is a world of objects that presupposes transcendently created objects—corpuscles, "mechanism[s]," or what-have-you—but cannot account for the subjects that experience these objects, Blake, much as Joseph Priestley had done in his discussion of a possible electrical basis for matter, argues for an immanent creative principle rather than a transcendent first cause.[21] That principle is what he calls "Poetic Genius," and it is the immanent informing principle of all bodies, human or otherwise. "Principle Ist" of *All Religions* states "That the Poetic Genius is the true Man. and that the body or outward form of Man is derived from the Poetic Genius. Likewise that the forms of all things are derived from their Genius which by the Ancients was call'd an Angel & Spirit & Demon" (p. 1).[22]

Without acknowledging the existence of this

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[18]*Paley's Natural Theology, with Illustrative Notes,* eds. Henry Brougham and Charles Bell (London: Knight, 1836) 3-4.

[19]Nor is the reification of the clockwork universe the only such instance of metonymic logic of Newtonian science leading to reification. See Zenon W. Pylyshyn, "Metaphorical Imprecision and the 'Top-Down' Research Strategy," in *Metaphor and Thought,* ed. Andrew Ortony (Cambridge: Cambridge Univ. Press, 1979) 420-36, esp 435. Pylyshyn identifies Newton as the scientist responsible for "the reification of geometry . . . accepting the axioms of Euclid as a literal description of physical space," an action that "profoundly affected the course of science" by proposing "a literal account of reality . . . that . . . enables scientists to see that certain further observations are possible and others are not." See also Funkenstein: speaking of "the physical universe" as understood by Newton and Leibniz, Funkenstein states that "It was an ideal clock—whether, as Newton thought, a clock that needed periodical rewinding or, as Leibniz insisted, a clock that runs perpetually with equal precision." As a specific result of the reification of the clockwork universe by Newton and Leibniz as well, "The mechanical philosophers of the seventeenth century came close to believing that, even if we can never hope to know all the facts about the universe, we know nonetheless enough of its dynamic principles to reconstruct its making in the way that God does" (317, 323).

[20]Blake's most powerful evocation of what happens when reified institutions invoke the "chartered" authority to speak for others is "London," where church and state use the authority vested in them by the Magna Carta (Great Charter) to speak for the chimney sweep and soldier, respectively. Then both combine in emphasizing the contractual nature of marriage, its unique franchise for sexual self-expression, and the double standard of sexual commodification and reification of gender roles and property relations that result in speaking for the harlot, whose only recourse is the rageful cursing of what has become, in several senses, a deadly institution. For an extended discussion of "London" along these lines, see my "Blake on Charters, Weights, and Measures as Forms of Social Control," *Studies in the Literary Imagination* 22 (1989): 37-59.

[21]See *The History and Present State of Electricity, with Original Experiments* (London: J. Dodsley, et al., 1767) xiii; qtd. in *Autobiography of Joseph Priestley,* ed. Jack Lindsay (Teaneck, N. J.: Fairleigh Dickinson Univ. Press, 1971) 19. Hans Eichner, "The Rise of Modern Science and the Genesis of Romanticism," *PMLA* 97 (1982): 8-30, esp. 24, notes that a significant shortcoming of "the mechanical philosophy" was "the impossibility of accounting for the interaction of mind and matter. . . ." Benedict Spinoza, *Ethic,* trans. W. Hale White, rev. Amelia Hutchison Stirling (London: Oxford Univ. Press, 1923) 22-23, argues in proposition 18 of that work, that *"God is the immanent, and not the transitive* [i.e., transcendent] *cause of all things."*

[22]In Blake's three terms, especially "Spirit," there is a strong suggestion that he favors the *J*-account of the creation over the *P*-account, and, more particularly, that he favors a gnostic reading of both accounts. For a fuller discussion of these proclivities, see my "Blake, Priestley, and Gnostic Moment," in *Literature and Science: Theory and Practice,* ed. Stuart Peterfreund (Boston: Northeastern Univ. Press, 1990) 139-66.

creative principle, one can never reason back to God, metonymically or otherwise; rather, one can only reason solipsistically. Blake's fourth principle reads, "As none by travelling over known lands can find out the unknown. So from already acquired knowledge Man could not acquire more. therefore an universal Poetic Genius exists" (p. 1). The source of this genius, as Blake tells the reader of his "Principle 7th," is not simply God, but God incarnated as Christ. "The true man is the source, he being the Poetic Genius" (p. 2).

The principle of Christ's inspired incarnational exemplarity is as unquestionably foundational to Blake's trinitarian metaphysics as it is repugnant to Newton's unitarian variant.[23] The "Conclusion" that follows upon the seven principles of There Is No Natural Religion [b] asserts that "If it were not for the Poetic or Prophetic character. the Philosophic & Experimental would soon be at the ratio of all things & stand still, unable to do other than repeat the same dull round over again" (p. 3). We would, in other words, be locked in precisely the sort of solipsism implicated in metonymic logic, replete with the Newtonian clockwork imagery that Blake's fourth principle evokes with its unflattering reference to "a univer[s]e [that] would soon become a mill with complicated wheels" (p. 2), were it not for the exemplarity in question. "Therefore God be-comes as we are, that we may be as he is" (p. 3).

Not coincidentally, both of the texts cited above are grounded on seven principles, seven being in Biblical numerology the number of greatest (and divine) completeness—for example, the seven days of the Hexameron, during which the plenitude of this world was created. By way of contrast, There Is No Natural Religion [a] sets forth six principles, six being in Biblical numerology the number of greatest (and worldly) incompleteness—for example, the insignia 666 on the forehead of Leviathan (Rev. 13:18). The seven-six distinction is a doubling of the metaphor-metonymy distinction, the former being characterized by full relationality and free (although not unmediated) transference, the latter being characterized by occulted

relationality and impeded transference. With its uncanny echoing of Boyle's description of the task of the "naturalist," this brief tract demonstrates what is wrong with "natural" man. Rather than bearing witness to God's love manifested in his assumption of human form—Blake's understanding of what it means ultimately for God to create humanity in his image—"natural" man creates God in his image, "naturalizing" and reducing him accordingly. Without "Poetic Genius" to transcend the limits of sense (and common sense)—without the mutuality of transference that allows "God [to] become[s] as we are, that we may be as he is," in other words—everything, including godhead, is reduced to terms of sense and defined in terms of what Blake calls "selfhood." As the fourth principle of this critique of natural theology states, "None could have other than natural or organic thoughts if he had none but organic perception" (p. 2).

As the conditionality with which the preceding principle is stated suggests, having "organic perception" that leads to "natural or organic thoughts" is a matter of choice or circumstance rather than of the human condition or unalterable fate. The alternative vision is strongly suggested by the second principle of No Natural Religion [b]. "Reason or the ratio of all we have already known. is not the same that it shall be when we know more" (p. 2). Whether choice or circumstance, "natural or organic perception" results from per-versity—literally a strong swerving from the inspired alternative.[24] This swerving, given one of the Greek roots of trope (trepein, "to turn"), may be viewed as the enactment of troping, of figuration. It is a willed turning away from the radiantly emanative source of "Poetic Genius," not a spontaneous turning to that source. It is a turning to look downward, not a turning to look upward, as the concluding lines of Night One of The Four Zoas, which portray aspects of Urizen and Luvah taking the form of the downward emanating gnostic demiurge, suggest. ("But perverse rolld the wheels of Urizen & Luvah back reversd / Downwards & outwards con-suming in the wars of Eternal Death" [p. 19, ll. 14-15].)

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[23]Richard S. Westfall discusses Newton's Biblical criticism of the 1670s, which was premised on the understanding "that a massive fraud, which began in the fourth and fifth centuries, had perverted the legacy of the early church," turning it away from the truth of a unitarian creed to trinitarian apostasy. See Never At Rest: A Biography of Isaac Newton (N.Y.: Cambridge Univ. Press, 1980) 312-24, esp. 313.

[24]See Donald Ault, Narrative Unbound: Re-Visioning William Blake's The Four Zoas (Barrytown, N.Y.: Station Hill Press, 1990) 196, 214. Something like this perversity underlies the fact that in Night IV, "Los consistently has been performing Tharmas' directions precisely in reverse order." So, too, "Night VI involves a counter-clockwise quest (backwards in time, thus repetitive). . . ."

Moreover, it is the swerving remarked by the bard-speaker of the "Introduction" to *Experience* in the lines

> Turn away no more:
> Why wilt thou turn away
> The starry floor
> The watry shore
> Is given thee till the break of day.
>
> (30.16-20)

If the world of *Experience*, with its topsy-turvy geography of the stars below and watery (rather than rocky or sandy) shores, is a world turned upside down, it is so largely as a function of "turn[ing] away." Matters will be, in several senses of the term, righted with "the break of day"—that is, in John of Patmos's terms, the dawning of "a new heaven and a new earth: for the first heaven and the first earth were passed away; and there was no more sea" (Rev. 21:1). Such is Blake's article of faith, realized—artistically, at least—in the Vision of Albion's announcement near the end of *Jerusalem* (1804-20), "For lo! the Night of Death is past and the Eternal Day / Appears upon our Hills" (97.3-4). But for the present time figured forth throughout *Experience*, in "The Tyger" as elsewhere, the perversity that arises from "natural or organic thoughts" is in the ascendant.[25] "The starry floor / The watry shore" anticipates narration of "natural" events offered by the speaker of "The Tyger."

> When the stars threw down their spears
> And water'd heaven with their tears:
> Did he smile his work to see?
>
> (42.17-19)

What the Bard sees as a "starry floor" (and what "the wheels of Urizen & Luvah" perversely project downward) is, for the speaker of "The Tyger," a starry ceiling, a point of view suggestive of the fact that he is one of the creatures who resulted from that downward projection. The speaker's point of view also causes him to get the surrendering of arms precisely backwards. If the stars in fact did what the speaker said they did, they would have set in place exactly those conditions necessary for another downward-tending gnostic genesis, the sort in which "the Spirit of God moved upon the face of the waters" (Gen. 1:2). From the perspective of dialectical visionary struggle, as it is presented in *The Four Zoas*, "The stars threw down their spears & fled naked away" (p. 64, l. 27).[26] That is, the stars relinquish the phallic symbol of hegemonic authority wielded by all male-dominated eighteenth-century establishments.[27] And when they do, the stars are relieved of both their oppressive duties of enforcement and their garments, characterized elsewhere (in *Milton* [1804]) as the metonymic (and potentially gendered) "rotten rags of Memory by Inspiration / . . .Bacon, Locke & Newton . . ." (41[48].4-5), and allowed to return to their emanative source.[28] Finally, the very idea that the stars are "naturally" supposed to water heaven suggests that the speaker of "The Tyger" projects upon heaven the aura of physical (and spiritual) dryness characteristic of rationalistic Deism, when in fact "the break of day" will reveal it as a powerful, divine emanative source

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[25]A number of commentators have identified "The Tyger" as an important and allusive locus of "natural or organic thoughts." For example, Rodney M. Baine, "Blake's 'Tyger': The Nature of the Beast," *PQ* 46 (1967): 488-98, identifies Buffon's *Histoire Naturelle*, Goldsmith's *Animated Nature*, and Lavater's *Essays in Physiognomy* as influences on the poem's symbolism. To Baine's attributions of influence, less Lavater, Coleman O. Parsons, "Tygers before Blake," *SEL* 8 (1968): 573-92, adds Linnaeus's *Animal Kingdom* and Smellie's *Philosophy of Natural History*. William S. Doxey, "William Blake and William Herschel: The Poet, the Astronomer, and 'The Tyger,'" *BlakeS* 2 (1969-70): 5-13, reads the poem against William Herschel's astronomical publications.

[26]The linkage between the passage in "The Tyger" and the passage in *The Four Zoas* was first remarked by David V. Erdman, *Blake: Prophet Against Empire*, 2nd ed. (Princeton: Princeton Univ. Press, 1969) 194-95.

[27]See Anne Kostelanetz Mellor, *Blake's Human Form Divine* (Berkeley and Los Angeles: Univ. of California Press, 1974) 65. "By 1793, Blake had often associated stars with the oppressions of monarchy and with a Newtonian, mechanistic conception of the universe." Elaine Pagels, *The Gnostic Gospels* (New York: Random House, 1979) 48-69, discusses the battle waged between the early Church Fathers and their gnostic opponents over God's gender and the gender-based worldly authority deriving therefrom.

[28]Abrams, in defining *metonymy*, observes, "typical attire can signify the male and female sexes: 'doublet and hose ought to show itself courageous to petticoat'" (Shakespeare, *As You Like It* 2.4.6 [66])." Urizen does not take part in this stand-down. He continues to exercise hegemonic male authority. Eighteen lines after the stars fled, "Urizen arose & leaning on his Spear explord his dens" (p. 67, l. 1). *Spear* itself may be viewed as a metonym, in the same sense that "a thousand guns" is a metonym for an armada of ships mounting that number of guns.

more usually associated with the evangelical sects—a pentecostal fountain, or "The Four Rivers of Paradise" (*Jerusalem* 98.25), among others.

Like his demiurgic original, Urizen has a considerable ability to create the landscape that, according to Blake, we mistakenly take to be the "natural" world. In fact, like Elohim in the *P*-account, he creates his world by *fiat*, in the very act of exploring the delusory Newtonian space that it occupies.[29] Thus the act that occurs at the very beginning of Night Six of *The Four Zoas*, where "Urizen arose & leaning on his Spear explord his dens" (p. 67, l. 1), gives rise to the landscape glimpsed near the beginning of Night Seven.[30]

> . . . fierce his lions
> Howl in burning dens his tygers roam in
>   the redounding smoke
> In forests of affliction.
>
> (p. 77, ll. 8-10)

This is the landscape of "The Tyger" viewed from the Urizenic perspective, which is the opposite of the speaker's perspective, just as the bard's view of a "starry floor" is the opposite of the speaker's view of starry skies. For example, where Urizen sees "tygers roam in redounding smoke," the speaker of "The Tyger" sees the "Tyger, burning bright, / In the forests of the night . . ." (42.1-2). As the image of tigers

[29]Ault, in commenting on *The Four Zoas* (p. 70, ll. 39-45), observes, "Urizen's Children perceive his words as landscape" (218). That is, by dint of metonymic logic they reason from material effect to verbal cause.

[30]There are interesting affinities between the image of Urizen leaning on his spear and Blake's color print of Newton. Discussing the print, W. J. T. Mitchell, *Blake's Composite Art: A Study of the Illuminated Poetry* (Princeton: Princeton Univ. Press, 1978) 49, asks, "Is this a night scene, a subterranean realm, or an undersea world?" One possible answer is that it is a print of Newton exploring his dens, much as Urizen explores his. That Newton leans on a pair of dividers rather than a spear poses no extreme difficulty. The dividers, a geometrical tool, is Newton's combat weapon of choice. Then too, if one follows the logic *Milton*, it is plausible to argue that Newton, like Blake's Satan, who is "Newton Pantocrator, weaving the Woof of Locke" (4.11), and who has not "the Science of Wrath, but only of Pity," creates the material universe of his dens in his own divided image, one that sees "Wrath" and "Pity," i.e., soul and body, corpuscle and immanent, immaterial principle, "Rent . . . asunder . . ." (9.46-47). Without wrath, that is, Satan/Newton/Urizen's spear is a divided spear, or dividers.

roaming in "redounding smoke" suggests, the tiger that the speaker encounters is ultimately without *telos* or theodical purpose—the truth of the matter is that it "roam[s]"—it is insubstantial, and it is a solipsistic if necessary material excrescence, no matter whether it be a material effect attributed to a divine cause, witness the "redounding smoke."

The speaker, however, buys into the Newtonian metonymic logic of natural theology and reifies the tiger in the very act of questioning it, his operative assumption being that the tiger is akin to Boyle's clocklike mechanism, and that he, as a "naturalist" playing the "mechanician," can gain some understanding of the Great Transcendent Clockmaker and Clockwinder himself. By the terms of such logic, the "fire" of the tiger's "eyes" is an effect that implies as its cause a (blacksmith's? lamplighter's?) "hand [that] dare sieze the fire[?]." The striated musculature of "the sinews of th[e] heart" is an effect that implies as its cause a cordwainer's "shoulder, & . . . art." The bilateral symmetry and involutions of the "brain" are effects that imply as their cause an extremely skillful blacksmith, equipped with "hammer . . . chain . . . furnace . . . [and] anvil" sufficient to have wrought that brain much as iron is wrought (pl. 42, passim).

I stated near the outset of this essay that the speaker creates the tiger in his fallen image, and indeed he does, with this important qualification: that the speaker's image is also Urizen's image, albeit inverted or reversed, suggesting perhaps that Blake slyly insinuates the optics of the convex lens or mirror into his topsy-turvy of the created world. I make the point as a way of making a start toward resolving the oft-remarked problem of resolving the fit of the poem to its illumination. The illumination is, as John E. Grant argues, something of a *jeu d'esprit*.[31] But the humor incidental to such a play should not be allowed to obscure its point: that the tiger is the misbegotten product of Urizen's deluded acts of creation and the speaker's correspondingly deluded acts alike.

As Pagliaro notes, the illumination is not so much of a tiger as it is of "a cat with human features" (87). In the Rosenwald Collection copy of *Songs* that served as the original of the Oxford University Press facsimile, these features include

[31]See "The Art and Argument of 'The Tyger,'" *TSLL* 2 (1960): 1-17.

a rather prominent, possibly Semitic nose; beady eyes, if one can infer the character of the eye not seen from that of the eye that is seen; a rather grimly set mouth and distinctly human jaw; and forelegs and forepaws that look more like arms and hands than like the animal homologues of these.[32] These very same features, rotated ninety degrees on the vertical axis to give a frontal rather than a profile view, and augmented by the addition of a markedly Urizenic beard, are seen in the human head depicted in the finis picture of plate 24 of *The Marriage of Heaven and Hell* (1790-93). The figure, moreover, is posed in precisely the same four-footed stance as the tiger. This human figure, identified by David V. Erdman as "the oppressor (King Nebuchadnezzar)," rests above the motto "One Law for the Lion & Ox is Oppression."[33]

Identifying the speaker of "The Tyger" as Nebuchadnezzar—or, at the very least, as someone with Nebuchadnezzar's literalistic, materialistic, authoritarian, idolatrous frame of mind—makes a good deal more sense than may at first be apparent.[34] To begin with, Nebuchadnezzar was king of Babylon, a state (and state of mind) that Blake equates with natural theology throughout his poetry. For example, at the conclusion of Night Eight of *The Four Zoas,*

> The Ashes of Mystery began to animate
>   they calld it Deism
> And Natural Religion as of old so now
>   anew began
> Babylon again in Infancy Calld Natural
>   Religion[.]
>
> (p. 111, ll. 618-20)

As one of the kings of Babylon, Nebuchadnezzar was, for a time, his nation's principal natural theologian.

Identifying the speaker as Nebuchadnezzar also gives an interesting spin to the images of

fire and furnaces in the poem—images the awe of which is tempered by the speaker's literalistic insistence on identifying the mode of the tiger's production. For their failure to pay worship a sixty-cubit-high golden idol that he has caused to be built, Nebuchadnezzar condemns the Jews Shadrach, Meshach, and Abed-nego to death in "the burning fiery furnace." The flames are so lethally hot that they kill the warders who toss the three in, but Shadrach, Meshach, and Abed-nego emerge unscathed. Nebuchadnezzar himself suspects that the miracle has been divinely caused—in effect, that it is the result of the action of divine transference in which a metaphor for God ("Son of God") provides the sustaining presence that enables mortals to transcend the material limits of their existence. As he says, "Lo, I see four men loose, walking in the midst of the fire, and . . . the fourth is like the Son of God" (Dan. 3:22-25).

Nebuchadnezzar is sufficiently impressed with the deliverance of the three by their God to decree, "That every people, nation, and language, which speak any thing amiss against the God of Shadrach, Meshach, and Abed-nego, shall be cut in pieces, and their houses shall be made a dunghill: because there is no other God that can deliver after this sort" (3:29). But he is not sufficiently impressed to change his ways or convert. His own stiff-necked literalism results in a figural distancing suggested by Nebuchadnezzar's unwillingness to admit that he has seen the actual Son of God, but to admit only that he has seen something "like the Son of God." If anything, he grows ever more prideful than he had become when Daniel prophesied Nebuchadnezzar's reign as "*a* [but not *the*] king of kings" (2:37; emphasis added), an event that caused the king mistakenly to "worship[ped] Daniel and command[ed] that they should offer an oblation of sweet odours unto him" (2:46), not to mention causing the huge golden idol to be built.

Until the end, Nebuchadnezzar just does not get the point. He regards Daniel, whose name in Hebrew means "God is my judge," not as a divinely inspired prophet (maker of metaphors), but as "Belteshazzar, master of the magicians" (manipulator of metonyms [4:9]). His prideful ways cause him to refuse worship to Daniel's God, even if Nebuchadnezzar does honor him with lip service, as it were. Finally, after dreaming a dream that he sees as portending his end, in terms highly reminiscent of those associated with the Tower of Babel

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[32]William Blake, *Songs of Innocence and of Experience,* ed. Geoffrey Keynes (1794; rpt. New York: Oxford Univ. Press, 1977) pl. 42.

[33]*The Illuminated Blake,* ed. David V. Erdman (Garden City: Doubleday, 1974) 121.

[34]Blake may also intend an oblique jab at Newton, whose *Observations on the Prophecies of Daniel, and the Apocalypse of St. John* (1727) sets forth an exegetical method that takes the prophecies to be enciphered history and reads them as historical narrative for the literal truth of the matter.

(see Dan. 4:22; Gen. 11:1-9, esp. 11:4-6), Nebuchadnezzar calls upon Daniel to learn that his fate is to be "driven from men" and to become, for a time, a mindless beast that "did eat grass as oxen, and his body was wet with the dew of heaven, till his hairs were grown like eagles' feathers, and his nails like birds' claws" (Dan. 4:33). But this is not Nebuchadnezzar's ultimate fate: he has a conversion experience. "Now I Nebuchadnezzar praise and extol and honour the King of heaven, all whose works are truth, and his ways judgment: and those who walk in pride he is able to abase" (4:37).

As is the case in the implied answer to the tiger-lamb question discussed in conclusion below, it all comes to one for Nebuchadnezzar, once the prideful and deluded natural theologian in him is able to see the error of his ways and repent. But before that moment comes to pass, distinctions of the sort that Blake engages—the distinction between memory and inspiration, the distinction between reason and inspired vision, the distinction between making-as-fabrication and making-as-*poiesis*, and the distinction between art as metonymic and metaphoric representation—are being played out in the Book of Daniel. And while such distinctions are operative, "One Law for the Lion," which is subsequently associated with Daniel, "& the Ox," which is clearly associated with Nebuchadnezzar in his grass-eating phase, "is Oppression."[35]

Only two issues remain to be dealt with: the significance of the incremental repetition that sees the last line of the first stanza ("Could frame thy fearful symmetry") tranformed to the last line of the sixth (!) and last stanza ("Dare frame thy fearful symmetry" [42.4, 24]), and the status of the question "Did he who made the Lamb make thee?" (1.20). In the first instance, the lack of any satisfying results from the metonymic interrogation that occurs throughout the poem may begin to suggest that his questioning—and, by extension, the supposed acts of the object of his questioning—constitute illicit usurpations and applications of creative force. What appears to be the result of the mere capability of a powerful, transcendent creator in the first stanza arguably appears, by the last stanza, to be a transgression, not in the least because the speaker is finally not persuaded by the very argumentative logic he mobilizes.

In the second instance, the answer is *yes*, the sacramentality of the Lamb of God is meant to heal the division of material body and immaterial soul that occurred when the unified gnostic entity Pistis Sophia (Faith Wisdom), in the throes of a failure of imaginative nerve, allowed the demiurge to emanate downward into the material sphere thinking that he was the creator of the universe. This creator made both the material lamb and the material tiger, the former of which is raised from metonymic to metaphoric status in the capacity of the Lamb of God, whose free gift is meant to redeem an otherwise fallen and deluded humanity. In Blake's cosmology, the same forces that conspire to enact the rationalized and rationalistic divisions of the universe also participate unwittingly in the healing of those divisions. To return, in closing, to Urizen's spear, it is the type of the spear that "the Sons of Urizen" use when

> They vote the death of Luvah & they naild
>   him to the tree
> They piercd him with a spear & laid him in
>   a sepulcher
> To die the death of six thousand years
>   bound round with desolation[.]
>   (p. 92, ll. 13-17)

In this account, Luvah is clearly the type of Jesus, who is similarly pierced with a spear after his crucifixion. In commenting both on that action and the decision not to break his legs, John says that "these things were done, that the scripture should be fulfilled . . . (John 19:36). The Logos was "in the beginning . . . the Word," God ineffable. Then "the Word was with God," Jesus as transferent, co-present, metaphoric extension of God. Finally, once again, "the Word was God" (1:1). Even that spearing, a cause which generates the effect of blood and water, is part of the movement from radiant unity, to a diminished, dimmer multeity, and once again to radiant unity that constitutes the fulfillment of scripture, with its resurrection, judgment of the living and the dead, and everlasting life. The tiger, the lamb, and our imperfect understanding of these are but faltering steps along what, for John and for Blake alike, is a certain way.□

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[35]Daniel recounts a dream of "four great beasts," beginning with "This first [which] was like a lion . . ." (7:3-4).

Michele Birnbaum

DARK DIALECTS: SCIENTIFIC AND LITERARY REALISM IN JOEL CHANDLER HARRIS'S *UNCLE REMUS* SERIES

Well, 'tain't ez you may say one er deze yer reg'lar up en down tales, what run crossways. Dish yer tale goes straight.
—Uncle Remus and His Friends *(1892)*

Joel Chandler Harris's dialect literature perhaps best represents the curious opacity of mimetic language. Pockmarked with apostrophes and gutted with elisions, Uncle Remus's tales, despite protestations to the contrary, not only run "crossways," they are likely to leave the reader cross-eyed. Although the written representation of Remus's speech grows increasingly dense as it attempts transparency, Harris assumes that language can reflect itself—a mimetic fallacy that underwrites his representation of the "negro dialect" in the nineteenth century. The fallacy dates to Plato's *Cratylus* and persists even in contemporary criticism, but the success of Harris's particular representations was made possible—indeed, made practical—by early political and pedagogical debates concerning a phonetic national language, marking linguistic independence from England, as well as by the literary representation of foreign tongues within American society.[1] Developed initially to distinguish international, and then intranational relations, written dialect functioned for over a century as social semiotic.[2] Harris writes within this tradition, although he saw the dialect literature in terms of social realism, and his proper function as reporter rather than author.[3] Considering his preservation of the "negro character" an act of patronage quite different from the "intolerable misrepresentations of the minstrel stage," Harris was nonetheless an inveterate segregationalist (*Songs* 39). His graphic representations of "negroisms" provided a valuable *visual* ranking in a post-Reconstruction society in which race was no longer necessarily visible. The orthographic deviation from the standard clearly discriminated black from white, literally reinscribing an ante-bellum racial and social order threatened both by miscegenation (interracial sexual relations made physiognomy and skin color racially ambiguous cues) and Reconstruction legislation (the advent of black landowners and office-holders left traditional class and status markers unclear). On the page, if not in the world proper, race appeared unproblematic and, most importantly, legible.

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[1] For a discussion of contemporary debates concerning speech mimesis, see Brian McHale, "Speaking As a Child in U.S.A.: A Problem in the Mimesis of Speech," *Language and Style* 17 (1984): 351-77. See also Gérard Genette, "Modern Mimology: The Dream of a Poetic Language," *PMLA* 104 (Mar. 1989): 202-14. Brian McHale finds fault with "so sophisticated a poetician as Genette" for what Genette himself criticises in his later article: the expectation that "full, exact, direct mimesis of speech ought to be possible, even if perfect representation of nothing else in the world is . . . presumably because in this case alone there is no disparity between the objects of representation (language) and the medium of representation (language again). . . . Genette qualifies *le récit d'événements*, the verbal representation of nonverbal happenings, as at best an illusion of mimesis, but grants the possibility of 'absolute' mimesis when it comes to *le récit de paroles*, the verbal representation of verbal happenings" (McHale 351).

[2] Of course, written dialect has been employed in England since the writings of Chaucer. However, I am here interested in the specific historical circumstances which gave rise to particular uses of literary dialect in the United States. For an excellent analysis of early debates concerning phonetic language, see David Simpson, *The Politics of American English, 1776-1850* (New York: Oxford Univ. Press, 1986).

[3] Joel Chandler Harris, *Uncle Remus: His Songs and His Sayings*, ed. Robert Hemenway (New York: Penguin, 1982) 10. All subsequent citations referred to as *Songs*.

Racial legibility served scientific as well as aesthetic ends—the former no less bound up in political exigencies than the latter. Comparative philology, focusing academic attention on speech types and, through phonetics, devising a technology of speech mimesis, elevated dialectal representation from an art to a science. In the process, however, literary conventions of dialectal representation developed in fiction were lent the authority of professional transcriptions, so that literary forms became formal markers of linguistic difference. The spelling of "gwine" in place of "going," for instance, became conventionalized among dialect writers, and was later adopted by many philologists. Philological organizations such as the American Dialect Association and the American Folklore Society claimed Harris's literary representations as empirical evidence of a species of speech; and in turn, philology enabled Harris to present the written dialect as the "phonetically genuine" and therefore "real speech" of blacks (*Songs* 39). In that sense, the science of language and dialect fiction shared a tautological relation: philologists depended upon linguistic specimens drawn from fictional sources, and Harris justified his literary endeavors, in part, by granting them the stature of a philological and ethnological exercise. He refers, for instance, to the serious efforts of philologists to "reveal the phonetics of Uncle Remus," pointing out that "the student of English, if he be willing to search so near the ground, will find matter to interest him in the homely dialect of Uncle Remus, and if his intentions run toward philological investigation . . . dozens of words . . . will open before him the whole field of the philology of the English tongue."[4] The *Uncle Remus* books did more than offer nostalgic portrayals of oldtime "darkies"; the dialect that Harris presented as authentic and unmediated speech provided the grist for the operations of a virtual industry based on linguistic taxonomy. Harris's Uncle Remus, in that sense, prefigured—and through the use by philologists of Harris's "records" actually enabled—a nineteenth-century preoccupation with the definition of a race-related dialect. The

biases which characterize written dialect in the nineteenth century—the fact that dialect registers a system of socially constructed difference—are not neutralized but naturalized under the aegis of empiricism. By conflating literary and linguistic discourse through the scientific institutionalization of literary transcriptions of speech, realists and philologists alike legitimized racialist (and inevitably racist) evaluations of language based on sociopolitical hierarchies. The collusion of science and literature in fact produced a linguistic map of these hierarchies, functioning indirectly to reestablish conservative ante-bellum social structures. For the purposes of this paper, then, I am not so much concerned with arriving at any "true" or mimetic relation between the spoken and the written as with the politics behind the procedures for articulating this relation.

In the 1880s, the myth of a transparent relation between script and speech suggested that language was reflective rather than constitutive. Yet the belief that language can be *representational* allowed for the construction of a language supposedly *representative* of race. The "negro dialect" came to signify a self-evident and homogenous speech community, despite the fact that it is a relational term, defined against Standard (white) English. As Mary Louise Pratt argues, the identification of categories of speech is never a neutral designation but always an ideological construction.[5] It is no accident, then, that "black dialect" in the nineteenth century was written almost exclusively by the dominant culture, beginning as white representation of black speech. Yet the increasingly systematic definition of black dialect at the end of the century was undertaken in the spirit of interracial harmony; in fact, comparative philology promised to be the model of scientific egalitarianism. The apparently benign designation of linguistic "families" supplanted the divisiveness of ethnological "races." Sanskrit, in its patrilineal primacy, made "akin" speakers of Indo-European languages regardless of possible discrepancies in exterior appearance (of the language or the skin). As Max Müller, the "father" of comparative philology, notes, "It is said that blood is thicker than water, but it may be said with even greater truth that language is thicker than blood. . . . A common language is a common bond of intellectual brotherhood, far stronger than any supposed or real community of blood."[6] The familial trope, of

[4]Joel Chandler Harris, *Uncle Remus and His Friends* (Boston: Houghton Mifflin & Co., 1892) vii. All subsequent citations referred to as *Friends*. For a discussion of the correspondence between Harris and "learned philologists and folklore students from England to India . . . royal institutes and literary societies," see Stella Brewer Brooks, *Joel Chandler Harris: Folklorist* (Athens: Univ. of Georgia Press, 1950) 23.

[5]"Linguistic Utopias," *The Linguistics of Writing: Arguments Between Language and Literature*, ed. Nigel Fabb et al. (New York: Methuen Press, 1987).

course, is familiar—the metaphor of the family naturalized power relations on ante-bellum plantations—and allowed philologists to recognize differences among speakers within a benevolent if hierarchized language system. Drawing on these fraternal bonds between speakers, Müller popularized comparative philology not only as the science of language but as the science of man, insisting that its linguistic categories ostensibly transcend all previous classifications, including that of race. Philology, therefore, satisfied the requirement of nonpartisanship considered intrinsic to the scientific method. Because Müller valorized the science of language as a step toward bonding disparate parties and peoples—the official goal of a country emerging from Reconstruction—the discipline's ideology was readily accepted by American academics such as William Dwight Whitney, perhaps the most notable linguist in the United States in the nineteenth century.

Both Whitney and Müller often dealt explicitly, and dismissively, with what they saw as the lesser and biased distinctions and methodologies of ethnology, a competing nineteenth-century "science of man." Yet the rhetoric of philology merely refigured discussions of race and masked the politics of its most mundane practice—specifically that of phonetics. The larger project of high-minded philological investigation depended upon the more routine collection, classification, and written translation of verbal objects. By extension, this dependence upon phonetic fieldwork rested upon a belief in the unimpeachability of empiricism. Philological positivism objectified language, casting it as a system of sounds rather than of signs, and phonetic transcriptions became the indispensable tool of the comparative philologist committed to the rigors of a neo-empiricism. The reduction of language into units of sound makes it particularly susceptible to "scientific" analysis because aural elements appear to represent both the fundamental and the material in language. The "phoneme," coined in 1875 by the Linguistic Society of France to replace Whitney's clumsier "letter of the spoken word," most notably marks the drive to encode language within scientific terminology, and thus to render it more amenable to analysis.[7] The term generated much of the technical lexography of the new science,

and its implied focus on the materiality of language influenced the methodology of philology in general. The representation of sound appeared to be the least suspect because it is apparently the most "objective" and factual; as a result, phonetics became the empirical ground and therefore the implicit justification for the philological enterprise.

The written representation of speech, however, replaces skin color as a physical marker of race. For Whitney, one of the achievements of phonetics is that it makes identity racial and observable, offering a more exacting colorline than ethnology. Classification, he argued, was more surely accomplished through language than physiognomy. Despite the fact that the scientific community imagined itself untainted by racism, Whitney made reluctant if telling equations between language and race, noting, for instance, that

> though languages are traditional institutions, they are of a special kind, capable of application to ethnological purposes far beyond any others. . . . Hence, when the ethnological relations of a community are to be settled, the first question is as to the affinities of speech.
>
> (*Life* 274-75)

In short, race may not always be visible, but it can be made visible; indeed, Whitney suggests that, given the litmus test of linguistic analysis, ethnicity always will out. The transcriptions revealed/constructed what skin color might conceal—in short, it prevented "passing": "Language shows ethnic descent, not as men have chosen to preserve such evidence of their kindred with other communities and races, but as it cannot be effaced."[8] Linguistic science, therefore, rather disingenuously insisted it was colorblind even as it suggested that language was colorfast. While the official rhetoric of the United States precluded recognition of anything but a classless, democratic society, then, philology offered reassuring—and seemingly objective—discriminations among classes and

[6]Max F. Müller, *Three Lectures on the Science of Language* (Chicago: Open Court Publishing Co., 1899) 34-35. Subsequent citations referred to as *Science*.

[7]William Dwight Whitney, *The Life and Growth of Language*, ed. Charles Hockett (New York: Dover Publications, 1875) xi. Subsequent citations referred to as *Life*.

[8]William Dwight Whitney, *Whitney on Language*, ed. Michael Silverstein (Cambridge: MIT Press, 1971) 24. Subsequent citations referred to as Silverstein.

races.

Whitney's position on race is complex, however, because he makes straightforward yet inconsistent statements regarding linguistics and ethnology. Rather than arguing for a one-to-one correspondence between race and language, he notes cautiously that "language is no infallible sign of race, only its probable indication" (Silverstein 91); yet elsewhere remarks that it "remains true that, upon the whole, language is a tolerably sure indication of race" (92). Perhaps his ambivalence is better understood in terms of what he actually wanted philology to offer with respect to race. It is not bloodtype but character type, not physical but social reality that language is meant to represent.[9] Character, like language, for Whitney, was not an a priori phenomenon, but to a large extent communally determined—a useful distinction in a segregated society. He explains, for instance, that in cases of "mixed blood," language is a "faithful and intelligible witness" (92):

> language tells us so much more respecting
> races than lie within the reach or scope of
> the physicist. . . . It is a picture of the
> internal life of the community to which it
> belongs; in it their capacities are exhibited,
> their characters expressed; it reflects their
> outward circumstance, records their
> experiences, indicates the grade of
> knowledge they have attained, exhibits
> their manners and institutions. Being itself
> an institution, shaped by their consenting
> through half-conscious action, it is an
> important test of national endowment and
> disposition, like political constitution, like
> jural usage, like national art. Even when it
> fails to show strict ethnic descent, it shows
> race-history of another sort—the history of
> the influence, which, by dint of superior
> character and culture, certain races have
> exercised over others.
>
> (92-93)

Whitney, then, could attack the linguistic Darwinism of August Schleicher, while still arguing for an even more devastating system of hierarchization.[10] Insisting that language is institutional rather than divine, he can nonetheless claim that performance if not descent distinguishes speakers one from another. Thus philology avoids the nineteenth-century debate concerning the poly- or ontogenetic origins of the human species, suggesting instead that the *contemporary* state of a community's language is sufficient to indicate whether or not a group is "successful" by Anglo-American standards. By focusing on cultural rather than biological sophistication, comparative philology not so much reconstructs a past but reassembles a present.

Perhaps it is here that philological practice most resembles the literary-dialectal project, for Whitney's argument assumes, and Harris's aesthetics necessitate, that the transcribed word indicates ethnic character. Pre-conceived ideological constructions of racial characteristics are reflexively encoded within a hierarchized, racially biased language, so that the "objective" transcription is informed by—and comes to inform—popular notions of race. Harris, for instance, is praised because his dialect is supposedly accurate—as a reflection of the *intended speaker* as well as his speech; for Harris, as for Whitney, linguistic mimesis suggests apolitical community analysis, even though it implies judgment of the viability of public and political life—on the "national endowment" of freed blacks. Commenting on the dialect in one of Harris's "negro tales," a Boston critic observed that it illustrated a

> fitness between sound and sense. . . . Mr.
> Harris is very close to the untutored spirit
> of humanity. . . . He uses rough or corrupt
> (in the philological sense) language to
> express only primitive passion and
> thought—he never offends or wearies by
> palpable incongruities between idea and
> form.[11]

The form, then, is pressured, coerced, by the content. Uncle Remus speaks like—must speak like—and about the things that a good plantation darky should. Any discrepancies in this correspondence are either offensive, as the

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[9]For discussions of nineteenth-century notions of race and "blood," see Henry Louis Gates, Jr., *'Race,' Writing, and Difference*, ed. Henry Louis Gates, Jr. (Chicago: Univ. of Chicago Press, 1986); and Stephen Jay Gould, *The Mismeasure of Man* (New York: Norton, 1981).

[10]For a comparison of Whitney with his contemporaries, see the introduction to Silverstein, previously cited.

[11]Joel Chandler Harris, *Joel Chandler Harris: Editor and Essayist*, ed. Julia Collier Harris (Chapel Hill: Univ. of North Carolina Press, 1931) 184. All subsequent citations referred to as *Harris*.

passage above suggests, or deliberately comic. The well-known dialect writer and editor Walter Hines Page, for instance, wanted Harris to "put into [his black character's] mouth an explanation once a month about some great thing of which he knew nothing about, but about which he would be willing to talk like a philosopher" (*Harris* 184). The notion that Uncle Remus's written dialect must be properly "negroid" reinforced the "zip coon" stereotype, especially popular during Reconstruction. In brief, the coon image displayed a gentrified freed black aping his white superiors, his lugubrious attempts to "speechify" defusing blacks' efforts toward intellectual as well as political equality by suggesting that they were laughable. Harris himself, in a letter to an editor of *Scribner's Magazine*, insists that form and content must be united—although it is not clear whether it ought to be, or inevitably and already is. The mimetic correspondence is both a scientific given and a literary imperative: "In all dialects, the thought exactly fits the expression—the idea is as homely as the words—and any attempt to reproduce a dialect must recognize this fact or be pronounced a failure" (183). At times the discrepancy is in fact disabling. Harris comments in the introduction to *Uncle Remus and His Friends* that "it is painful indeed, when the form of lingo trails on the ground and the thought flies in the air" (*Friends* vii).

Although dialects were often identified geographically, philological journals such as *American Speech* and *Dialect Notes* began to classify "negro dialect" as race—rather than locale—specific. Harris claimed, in fact, that dialect and race were inextricably linked—"only in this shape [literary dialect] . . . would it be possible to adequately represent the shrewd observations, the curious retorts, the quaint comments, and the humorous philosophy of the race of which Uncle Remus is a type" (*Songs* 46). His descriptions of the appearance of the dialect as "homely" are an opinion worth noting because the same aesthetic judgment often informed philologists' evaluations and justified early physiological research of speech which further reinforced black stereotypes (39, 46). Whitney's linguistic economy, for example, held that the more abbreviated the grammatical forms, the more corrupt the language and the more primitive the speakers' abilities. Thus the construction of a "negro dialect" on the page, which (re)presented derivative and thwarted

forms, seemed an example of "the lazy habit of mouth which has occasioned the dimming of so many of our clear vowels" (*Science* 43):

> Words were beheaded, curtailed, conglomerated, broken. . . . The negro had an idiom all his own . . . a degraded tongue. . . . The tongue and the brain of the old slave followed the channel of least resistance. With the negro the aim seemed to be to either shorten and simplify and to drop letters which require an effort, or to show his 'smartness' by using words too big for his comprehension, and thus to torture them.[12]

Such attitudes justified benevolent intervention which at once assumed the inferiority of dialectal speakers as it attempted to educate them. Much of Whitney's work, for instance, with the Spelling Reform Association (1876), was based on the belief that applied linguistics must engage in the "enlightened, planned change of human institutions" (Silverstein xiii), and it was with this program in mind—the study and standardization of language in the name of social progress—that Whitney wrote for popular magazines such as Henry Adams' *North American Review*, as well as helped found organizations such as the American Philological Association (1869), the Modern Language Association of America (1883), and the American Dialect Society (1889). Standardization of language, then, sought to unify national tastes. However, it also reinforced the negative aesthetic reception of written black dialect. The orthographic deformation and increased textual opacity violated aesthetic expectations cultivated by a half-century of standardizing dictionaries and didactic spelling manuals that emphasize the gentility of proper orthography. The prominent literary editor and satirist James Kirke Paulding, for instance, implied that refined sensibilities would be repelled by the "French revolution of the alphabet" that literary dialect incited, remarking half-seriously that British reviewers "immediately put the [offending word] in italics, or post a tall note of admiration at the end, to allure [their] readers to come and gaze at this curious transatlantic monster" (Simpson 127). Similarly, Müller specifically describes the dialect as a "monster," explaining that "the mischief wrought by pho-

[12]John Uri Lloyd, "The Language of the Kentucky Negro," *Dialect Notes* 2 (1908): 180.

netic decay seems enormous in that Negro jargon. . . . The confusion created by dialectic growth is puzzling in the mixed idiom of these slaves."[13] Literary dialect was not simply deviant, it was grotesque spectacle.

The misshapen form of dialectal representation further reinforced the xenophobic response to blacks, who were still widely considered alien to the country. Harris, for example, only three years after *Uncle Remus: His Songs and His Sayings* (1880) was published, wrote that "it is neither pleasant nor safe to have large numbers of an alien and inferior race, armed with the power and dignity of citizenship, and yet totally ignorant and careless of its responsibilities" (*Harris* 167). At a time when black literary efforts were largely directed toward imitation of white genteel models, the rising number of plantation dialect tales portrayed blacks as either exotic creatures or all-too-familiar darkies, thwarting the "assimilationist" New Negro movement.[14] In fact, the frequent use of literary dialect in the United States as a kind of linguistic minstrelsy—or worse, because more insidious in its consequences, as the unproblematic representation of a black speech type—plagued early Harlem Renaissance writers such as Paul Laurence Dunbar. Pressured by his patron, William Dean Howells, to write only in dialect because it best represented his race, Dunbar eventually came to feel complicit in perpetuating degrading stereotypes. His ambivalence precipitated heated debates concerning the role of black dialect and its implications for the "uplift" of the race.[15]

It is important to ask, then, why some speech groups warrant phonetic transcription over others. Whitney's comment that the "speakers of language . . . constitute a republic, or rather, a democracy" illustrates the separate-but-equal

fallacy that still often plagues contemporary linguistics.[16] The speakers determined to have dialects (non-prestige or otherwise) have little vote in the mode of their representation; in fact, written dialect poses as a representative when often it has no constituency—it presents speech spoken by no one. One needs to examine the initial choice to encode orthographically the sound of a particular speech community in fiction as well as in formal representations—and further, to track the ways in which these transcriptions are actually constitutive of such communities. As I have earlier suggested, it is not spoken dialect (colloquialism, koine, vernacular) which is so troublesome, but the project of rendering the phonetic dimension of speech. The racist consequences of representations of speech in the 1880s are enabled by the theoretical idealization of the correspondence between the utterance and its written representation, by the assumption that the scientific and the fictional are simply poles on some mimetic continuum, wherein "scientific" transcriptions are closer to the "real" than fictional versions. The belief that only accuracy is at stake in linguistic representation arises out of a nineteenth-century epistemology which equates truth with the transparency of fact; that is, if one can only get to raw fact there is need to look no further for the truth. It is no accident that Harris's presentation of Uncle Remus's speech seems so self-evident as to preclude further inquiry; that written dialect is not a pretty sight nor an easy read emphasizes the fact that it appears to be the genuine article, an unpolished unedited artifact:

> One day atter Brer Rabbit fool 'im wid dat calamus root. Brer Fox went ter wuk en got 'im some tar, en mix it wid some turkentime, en fix up a contrapshun wat he call a Tar-Baby, en he tuck dish yer Tar-Baby en sot 'er in de big road, en den he lay off in de bushes fer ter see wat de news wuz gwineter be. En he didn't hatter wait long, nudder, kaze bimeby here come Brer Rabbit pacin' down de road.
>
> (*Songs* 58)

Both literary critics and linguists take Harris at his word when he claims that he is simply

[13]Max F. Müller, *The Science of Language* (New York: Charles Scribner's Son, 1891) 227.

[14]Of course the term "assimilationist" is problematic. See Houston Baker, *Modernism and the Harlem Renaissance: A Vernacular Theory* (Chicago: Univ. of Chicago Press, 1987).

[15]See James Weldon Johnson's 1922 and 1931 prefaces to *The Book of American Negro Poetry* (New York: Harcourt, Brace & Co., 1931). For a review of Dunbar's complicated relationship with his white patron, William Dean Howells, see Elsa Nettles, *Language, Race, and Social Class in Howells' America* (Lexington: Univ. of Kentucky Press, 1988). The effect of the scientific and literary constructions of (and on) black dialect on the African-American literary tradition is profound, and unfortunately deserves more treatment than I can here give it.

[16]William Dwight Whitney, *Language and the Study of Language: Twelve Lectures on the Principles of Linguistic Science* (New York: Charles Scribner's Sons, 1895) 38.

recording "the quaint dialect . . . without embellishment and without exaggeration" (*Songs* 30).[17] One could take issue, of course, with the problem of "eye-dialect"—spellings which do not reflect difference in pronunication but imply illiteracy or ignorance—such as "constrapshun" or "wuz." Yet this only hints at the larger theoretical and ideological dilemma. Standard(ized) English spelling does not correspond to some standard pronunication—although it perpetuates the myth of non-dialectal speech.[18] So if spelling was never meant to signify precise vocalic variation, why—or under what condition—argue for an isomorphism between sound and letter? Written dialect, like literary realism and comparative philology generally, does not reflect the "real" world or even "real" speech; it represents the epistemological systems devised to understand both. As Susan Stewart explains, representations of the real are not about the "real" at all:

> As genres approach 'realism,' their organization of information must clearly resemble the organization of information in everyday life. Realistic genres do not mirror everyday life; they mirror its hierarchization of information. They are mimetic of values, not of the material world. Literature [and I argue science] cannot name the world; it must name the social.[19]

In fact, written representations are at best only derivatively tied to actual speech habits. Brian McHale's theory of linguistic stereotypes suggest that transcriptions are both a conventionalized and generalized version of heard speech. These stereotypes, he argues,

manifest in "jokes, parodies—and in fiction" are the layperson's image of a speech variety *"that he does not actually use himself"* (136; emphasis mine). Dialect, then, and particularly Harris's representation of the fictional Uncle Remus's dialect, always constitutes the speech of the "other," in that a distance, imagined or not, is maintained between the representer and the represented speech. Those who might forget this imperative are reminded by the white narratorial voice which prefaces the collections of the "negro tales"; Harris's introductions, written in standard prose, both in form and in content distinguish themselves from the dialect as they set the context for it. He apologizes for "both the matter and the manner" of the dialectal representations, emphasizing their "low" but therefore philologically valuable nature.[20] The introduction to the first edition of *Georgia Scenes*, in a similar tone, includes this polite but insistent disclaimer for those put off by "the coarse, inelegant, and sometimes ungrammatical language, which the writer represents himself as occasionally using . . . *is the language accommodated to the capacity of the person to whom he represents himself as speaking"* (Simpson 144).

Although, in this sense, transcriptions are cultural productions, recent research in dialectology suggests that dialectal representations are a matter of epistemology as well as hegemony. In other words, because the individual who represents speech measures another's pronunciation by his or her impression of the "standard" (against internalized values s/he considers his or her own speech to model), the written result of such an attempt is as much a problem of perception as of power relations. Sumner Ives, in his seminal article, first touched on the idea that literary dialect is a linguistic translation of this act of aural discrimination, by suggesting that the author may, "without consciously wishing to deceive, exaggerate slightly the frequency of dialectal features, for he will perceive peculiarities more readily than he will notice usages that may sometimes appear in his own speech" (147). The "peculiarities" which constitute written dialect, then, are as much a function of the representer as the represented. The presentation is itself an interpretive act.

Linguistic science cannot purge literary dialect of its "peculiarity," despite its claims to

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[17]The linguist Sumner Ives, for instance, praises Harris's ability to represent "the real speech of real people," "Toward a Theory of Literary Dialect," *Tulane Studies in English* 2 (1950): 137-82.

[18]For an excellent discussion of the prescriptive and politicized nature of the so-called standard English, see Tony Crowley, "A History of 'The History of the Language,'" *Language and Communication* 6 (1986): 293-303; and "An Analysis of the Term 'Standard English' in the Work of Two Twentieth-Century Linguists," *Language and Communication* 7 (1987): 199-220.

[19]Susan Stewart, *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection* (Baltimore: Johns Hopkins Univ. Press, 1984) 26.

[20]Joel Chandler Harris, *Nights with Uncle Remus* (New York: Routledge & Son, 1892) 1. Subsequent citations referred to as *Nights*.

objectivity, because the representation is itself a product of mediation. The rendition of speech bears only a twice-removed relation to naturally-occurring speech, which is "actually a selection from a stereotypical repertoire of features, a selection from a *preselection*, an imitation of an imitation" (McHale 362). Refining Ives' suggestion that dialect is a matter of "generalization and selection" from "real speech," McHale proposes that the mimesis of speech types based on "*preselection*, by the mediation of 'linguistic stereotypes,' and *contextualization*" (353) is necessary to "decode" (362) the character speaking according to some social framework or racial classification in order to provide interpretive cues to the reader. Harris's written dialect may be an attempt to capture the Gullah dialect (*Nights* 16), but it more directly reflects the white literary conventions (well-standardized by the 1880s) guiding its representation. Literary dialect, then, is engaged in a linguistic confidence game: it bills itself as real when in fact it is idealized; it purports to be the speech of "folk" when in fact it is an artificial device; it appears to be a straightforward performance when in fact it is a kind of white blackface.

The problem of mediation is perhaps most acute in the generic blurring between the scientific article and dialect literature. Elisha Kane's article "Negro Dialects Along the Savannah River," appearing in the established philological journal *Dialect Notes*, is both a racist and a representative philological document. Kane begins the piece by characterizing the dialectal speakers as a means to authenticate their speech and his transcriptions as "genuine." He recounts his journey to the "darkest part" of the South, along "abominable roads meandering God knows where," finds the blackest subject, "a woman blacker than the blackest shadows," and the blackest place, a "negro grave-yard."[21] The preface presents both the context of and the implicit occasion for the transcription; it functions at once as theoretical explanation and ideological overdetermination. The transcriptions themselves accumulate to form a "tale," entitled "The Woman That Was Four Hundred Years Old," which itself appears

within the larger article, an elaborate enfolding which both constructs and controls interpretation of the speech represented. The tale displays all the conventions of dialect fiction, although Kane declares it is fact reconstructed from "memory" (354); the specificity of his digressions concerning "negro funerals" assumes the weight of technical observation even as they reveal a condescension typical of plantation tales:

> The survivors of the deceased, with true philosophy, when the inevitable hour comes, prefer to have an elegant funeral, which with them is synonymous with a protracted picnic, rather than waste the money on a bit of [tomb]stone. Still these [burial] mounds show an expenditure of affection which is as lavish as it is pathetic. . . . Bits of broken blue china, fragments of green and amber bottles, quartz pebbles often covered with tinfoil, a faded cotton flower from an abandoned hat, some mother of pearl ornament from an umbrella handle, in fact every sort of gilt and glitter which constitutes the treasure of a Jackdaw's nest, is used by the negroes to decorate their graves with. Lately, around Augusta, the tiny coons have been buying wonderful wax flowers which are housed under glass tumblers, but it will be a long time before such glory percolates through the poverty of the country.
>
> (355-56)

Kane's "subject," in fact, seems barely human; she is "a total eclipse save for a pair of sorrowful bloodshot eyes," and glances at him "furtively as she knelt on the mound, resting her weight upon her knuckles as only negroes and monkeys can" (356). The "aunty" is one of "those old time niggers" (356) whose speech—like everything else about her—is still uncivilized, according to Kane. Indeed, his intent in his prefaces appears to be to emphasize the primitive and alien nature of the speakers. The second tale he includes, for instance, explains how he came upon a black church meeting at which he saw "nothing but a sea of bobbing black heads, for all the world like a bit of flypaper completely covered with flies. In spite of the horrific odor that sultry afternoon, I stuck to my post" (362). While sticking to his post, as it were, the scientist on assignment nonetheless becomes the travelogue narrator, and his "objective"

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[21]Elisha Kane, "The Negro Dialects Along the Savannah River," *Dialect Notes* 5 (1925): 354-57. Kane's article was published the same year as Alain Locke's *The New Negro* anthology, a collection of prose, poetry, and art aimed at refiguring just those stereotypes that Kane traffics in.

authority merges with narratorial omniscience. In fact, in his second piece, "The White Brother Hears the Parable of the Lord and the Sick Chicken," the narrator jokingly equates the perspectives of the divine and the scientific: "the Omnipotent, like myself, might be hanging around out of curiosity for a negro church in action is a strange and wonderful thing" (361). Thus, when the *New York Times* hails Harris in the same breath as both a "philologist of no small merit" and an "admirable raconteur," it points to the way in which both linguists and fiction writers make experience similarly narratable, perhaps because, as Kane's comment implies, they both construct and occupy the same hegemonic narratorial position.[22]

The racist *context* of Kane's transcriptions is obvious, as is the *content* (the four-hundred-year-old woman, for instance, tells a tale which presents her as both superstitious and simple-minded). But the transcriptions are problematic beyond the "tales" they tell. He records the speaker's dialect in "the conventional spelling which all writers on negro dialect use" as well as phonetically (354). As with Harris, he uses the literary conventions to pigment the prose—"the conversation seems bare and colourless when written in the queen's English" (355)—although he criticizes the conventional spelling because it insufficiently registers differences among blacks, and is too frequently used by "writers who imagine that just because a dialect is spoken by a nigger it must be the same in Virginia, Florida, or Louisiana—which is anything but the truth" (354). Yet even as he argues for the recognition of diversity, all difference resides outside the white community. He is both praising and slighting when he insists that "there is greater and more colorful variety among negro dialects than exists among the white people of our nation" (355), reiterating Whitney's comment in "Language as a Barrier between Man and Brute" that "it is precisely among the lowest and least cultivated races of man . . . that dialectal diversity is greatest."[23]   ˋ

The transcriptions themselves reinforce the idea of a monologic standard, naturalizing "white" speech. There are usually several lines

of script paralleling each other: the narrator's comments, his more colloquial interrogations (both in standard orthography, although the inquiries are distinguished by quotation marks); the representation of the dialect speech according to literary convention; and, directly beneath that, the dialect speech phonetically transcribed. Each stacked "level" decreases in familiarity. In one sense, the standard sets up and sets off the dialectal representation as variant. Yet the phonetic transcriptions— supposedly the most authoritative renditions of the "negro dialect"—are also the most peculiar. Claiming the most direct correspondence to the oral, to the "real," the scientific is nevertheless impenetrable, alien. Kane claims that the transcriptions are central to the article, yet they serve only as a kind of gloss to the dialect tale—the transliteration fails to translate the "curious" speech of the black woman; it only reinforces what the narrator has already characterized as strange, and what Harris calls the "confused and untranslatable" aspects of some dialects (*Nights* 16). The voice of science, therefore, is also presented as foreign, yet the phonetic transcriptions seem only to enhance the aloof and abstract quality of formal science, and to testify to the "objective" and strictly isomorphic representation of the subject under study.

Kane's phonetics, in a sense, attempt to reify ethnicity through scientific codification. Between the lines, however, is a gap which Kane cannot fill—that is, he cannot quite get to what Ives calls the "more literal truth than they would have recorded with the standard spelling and the conventional grammar" (138). The transcriptions, by juxtaposition, may authorize the literary dialect, yet like Harris, Kane yearns to make writing speak race—speak, paradoxically, the "curious exhaltation of mind and temperament not to be defined by words" (*Songs* 39). In this case, the typeface is only blackface—illustrating a representation of race that more closely represents the representer's performance.

A critique of the complicit and mutually enforcing projects of literary dialect and comparative philology should not suggest that linguistic science ought to or even could inoculate itself against the contamination of tropic language in order to become more stringently "objective." The trope of objectivity can itself be oppressive, ignoring the violence that so-called disinterest can wreak upon the

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[22]Paul M. Cousins, *Joel Chandler Harris: A Biography* (Baton Rouge: Louisiana State Univ. Press, 1968) 130.

[23]William Dwight Whitney, *Max Müller & The Science of Language: A Criticism* (New York: D. Appleton & Co., 1892) 33.

objects of its attention. As one critic argues, philology does harm simply by assuming the "existence and knowability of a certain *intrinsic* property of objects of discourse in general . . . named truth."[24] Too often the reconstructive nature of this scientific project is ignored, so that philology does not see itself as an agent of change, at least not directly, and thus does not take responsibility for its invention of a "narrative or a myth of a beginning to legitimize . . . some kind of intervention on an object constituted as an other" (Folena 221). Arguing, as Whitney does, that philology is an objective spectator which simply bears witness to phenomena, one may easily overlook the ways in which the science of language is not passive but participant in the world it claims to observe.[25] At issue, therefore, is not whether or not scientists and writers acted in good faith—a

plea for the redemptive function of science is the explicit goal of both Whitney's philology and Harris's dialect fiction. Clearly, however, simply bringing facts "to the light of day" does not recoup dim truths, because in the name of objectivity and enlightenment, scientific patronage and literary idealism may in fact raise the spectre of racism in darker if less visible forms.□

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[24]Lucia Folena, "Figures of Violence: Philologists, Witches, and Stalinists," *The Violence of Representation: Literature and the History of Violence*, eds. Nancy Armstrong and Leonard Tennenhouse (New York: Routledge, 1989) 220.

[25]For further discussions of the problems related to speech mimesis, see John Wilson, "The Sociolinguistic Paradox: Data as Methodological Product," *Language and Communication* 7: 161-77; John Lipski, "Prejudice and Pronunciation," *American Speech* 51 (1976): 109-18; Dennis Preston, "The Li'l Abner Syndrome: Written Representations of Speech," *American Speech* 60 (1985): 328-36; and William Labov, "Objectivity and Commitment in Linguistic Science," *Language in Society* 2 (1977): 165-201.

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TURBULENCE IN THE TEXT:
NARRATIVE COMPLEXITY IN *MRS. DALLOWAY*

[A]n analysis [of the positive basis of knowledge in culture] does not belong to the history of ideas or of science: it is rather an inquiry whose aim is to rediscover on what basis knowledge and theory became possible; within what space of order knowledge was constituted; on the basis of what historical a priori and in the element of what positivity, ideas could appear, sciences be established, experience be reflected in philosophies, rationalities be formed, only, perhaps, to dissolve and vanish soon afterwards.[1]

Like Michel Foucault, contemporary critics of science and literature have undertaken an inquiry into the conditions that result in self-similarities within specific cultures. In keeping with this project, I would like to investigate the relationships between the literature of "high modernism" and simultaneous developments in early twentieth-century physics, specifically the narrative complexity of Virginia Woolf's *Mrs. Dalloway*, first published in 1925, and the concurrent theoretical modifications of classical dynamics that were moving physics away from deterministic and reversible descriptions of nature and toward the acceptance of stochastic and irreversible processes.[2] I would argue that Woolf and the physicists involved in the early twentieth-century debate about the implications of entropy and uncertainty were ultimately concerned with the ontological status of the objective observer, a fictionalized position that receded from view the more fiercely it was sought. For the scientists as well as for Woolf, the observing man/woman dissolved into a Laplacean god who, in seeking to control, paradoxically became subject to the limitations of his/her position. I see in this recognition of limitation what they could not help but see: the break-up of eighteenth- and nineteenth-century epistemology and the narrative forms that the search for objective knowledge took. These epistemological changes necessitated new structures of thought: scientists recognized

difficulties in clearly seeing, much less mastering, the natural world; writers, like Woolf, worried about the authoritarian bias of linear, "realistic" narrative. Both of these "recognitions" bespeak a search for new conceptions of order self-consciously different from the linear or hierarchical models of the past in their efforts to decenter the role of the thinking subject and to resituate the observer within the complexities of nature, and, in Woolf's case, culture.

In *Order out of Chaos*, Prigogine and Stengers reconceptualize the radical changes in chemistry and physics that occurred in the 1920s.[3] In contrast to the mechanistic and determinist worldview that dominated Western science prior to the 1920s, Prigogine and Stengers posit a new conception of nature emerging in this decade, so different as to be called another "culture" (xxviii). This new worldview is not governed by time-reversible fundamental laws; it takes into account the existence of irreversible processes and random fluctuations, phenomena that are excluded from Newtonian paradigms of the natural world. The positions of observer and origin are privileged in classical dynamics; in modern paradigms both positions are problematized.

The classical science that Prigogine and Stengers describe rested largely on Newton's *Principia* (1687) and later revisions and rereadings of the work.[4] The *Principia* develops Newton's two most influential principles: inertia

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[1] Michel Foucault, *The Order of Things* (New York: Random House, 1973) xxi-xxii.

[2] Virginia Woolf, *Mrs. Dalloway* (New York: Harcourt, Brace, Jovanovich, 1953).

[3] Ilya Prigogine and Isabelle Stengers, *Order out of Chaos: Man's New Dialogue with Nature* (New York: Bantam, 1984).

[4] Isaac Newton, *Principia*, trans. Forian Cajori (1934; rpt. Berkeley: Univ. of Calif. Press, 1962).

and gravity. Newton illustrated the principle of

Newton himself noticed contradictions in the schema of classical dynamics, recognizing that "an irreversible loss of motion is involved in each hard collision" (62). He suspected, in other words, the shortcomings of a paradigm that allowed for only energy-conservative and reversible trajectories. The fact that the universe inertia "by reference to projectiles that continue in their forward motions 'so far as they are not retarded by the resistance of the air, or impelled downward by the force of gravity.' "[5] The supposition upon which the principle rests is the notion that a body will remain at rest or move along a straight line at a constant speed forever. The elliptical motion of the planets is caused by two conservative linear forces—inertia and gravity—acting on each planet at the same time, at right angles to each other. Inertial force, always tending toward its own straight line, keeps the planet from being drawn into the sun by the latter's gravitational field. Newton's triumph, as Prigogine and Stengers note, lay in his solving through differential equations and integral calculus the problem of acceleration involved in inertia and gravity. In order to describe the state of a body at any given instant, Newton introduced the mathematical concept of infinitesimal quantities: "change is broken up into an infinite series of infinitely small changes . . . [acceleration] can then be calculated by integration, by adding up the infinitesimal velocity changes occurring during [a finite] interval" (58). The integration leads to the calculation of trajectories—determined by initial states and determinable through mathematics.

Prigogine and Stengers, as well as Serres and other historians of science, find in the implications of Newton's trajectories the basic characteristics of lawfulness, determinism, and reversibility. The calculation of trajectories presupposes "an empirical definition of a single instantaneous state of the system" (60). All bodies of a system, determined by the same initial conditions and the same forces, have equivalent trajectories, "each reflecting the arbitrary particularity of an initial condition."[6] Thus Newtonian dynamics includes the theoretical possibility of the reversibility of

[5]Qtd. in Bernard I. Cohen, *The Birth of a New Physics* (New York: Norton, 1985) 153.

[6]Prigogine in Michel Serres, *Hermes: Literature, Science, and Philosophy*, eds. Josue V. Harari and David F. Bell (Baltimore: Johns Hopkins Univ. Press, 1982) 145.

trajectories: "[t]he mathematical or logical system is independent of the time variable; the ordinary mechanical system depends on a time but not on its direction" (71). The origin necessary for the calculation of the system will not disappear; it is a measure of its primacy that theoretically it can be reattained.

did not collapse in on itself was a mystery to Newton, and he could only attribute the stability of things to God, an inexplicable force outside the system:

> This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being. And if the fixed stars are the centres of other like systems, these, being formed by the like wise counsel, must all be subject to the dominion of One; . . . and lest the systems of the fixed stars should, by their gravity, fall on each other, he hath placed those systems at immense distances from one another.
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> (2: 544)

The inconsistencies within Newton's "system" are thus "solved" by an omnipotent deity who could, and necessarily did, intercede in the workings of the universe. After Newton, these contradictions in the system were treated as technical problems that could be solved internally, the role of an intervening God was repressed, and dynamics was embraced as a coherent and complete model—because, I would argue, the paradigm fit the ideological requirements of the later seventeenth, eighteenth, and early nineteenth centuries for an objectified vision of man as the interpreter of nature. The beauty of classical dynamics for Newton's contemporaries and successors consisted in the socio-political ramifications of a moving model absolutely determined by its point of origin. Dynamic equations require the assumption that a static point of origin exists, and that bodies move away from this point in calculable trajectories. All that is required was an a priori "push"; hence God is redefined not as omnipotent and intervening but as an omniscient prime mover. In theory, all bodies in the universe would tend to move away from this originary point in a straight line forever—always determined by the same force, never independent of, or "forgetting," their essential beginning.

This outgrowth of dynamics, however, does

more than redefine the position and function of God; it assumes the possibility of uninvolved but omniscient observation to which man has access. Because Newton's laws of motion could "mathematically determine the precise motion of all particles in the universe," Laplace could theorize the possiblity of "an intellect which at a given instant knew all the forces acting in nature, and the position of all things of which the world consists"; this vast intellect would then be able to "embrace in the same formula the motions of the greatest bodies in the universe and those of the slightest atoms; nothing would be uncertain for it, and the future, like the past, would be present to its eyes."[7] The premise of the originator, outside of the system and outside of time, defined the position of uninvolved and unlimited observer—according to Foucault the cornerstone of the classical episteme. The position of omniscient observer, as a displacement of God as prime mover, retains in its separation from the system the potential for acting upon it. This potential, according to Prigogine and Stengers, was one of the chief attractions of classical dynamics: it implied control. "Newtonian" science is an active science, "a continuation of the ageless efforts of man to organize and exploit the world in which he lives" (37). Although I would argue that the effort was less "ageless" than related to a specific age of imperial expansion and industrial exploitation, the association of isolated observer—unfettered subject—with potential power over what s/he observes seems an accurate recognition of the ideologically defined nature and function of classical dynamics.

It is this position of objective observer that is at stake in the shifting paradigms in a number of disciplines in the early twentieth century. During Woolf's lifetime the possibility of observing, analyzing, or knowing became enormously complicated as the decentering of notions of objectivity redefined the limits of scientific knowledge. Universal objectivity has broken down in our century, and because, as Hayles argues, "a strict separation between subject and object is not possible [now . . .], there are inherent limits on how complete our

knowledge of any physical system can be" (18). Einstein's Special Theory of Relativity, as Hayles points out, states that observation is relative to the positionality of the observer, whether man or machine: "measurements of time, mass, and length are not absolute quantities but subject to change, depending on the reference frame from which they are made" (46). It becomes impossible to observe the whole from a frame of reference outside of it; we are irrevocably within our universe, and the authority that would have enabled us to speak of it in terms of truth or fact has been undermined. In quantum mechanics, Heisenberg's Uncertainty Principle takes this rejection of objectivity one step further. Heisenberg found that the precise location and velocity of a particle cannot be known simultaneously because the act of measurement influences the particle's course: "as the momentum becomes more precise because the particle is not disturbed as much, the position measurement grows less precise. The more precisely the momentum is known, the less precisely the position can be known" (Hayles 51). Because there is no way of knowing or measuring a system without interacting with it and therefore influencing it in some way, there is no place for the observer/god, who can determine the future and the course of all particles: "the uncertainty principle makes it impossible to predict the precise behavior of individual atoms, let alone the universe" (Kaku and Trainer 50).

The revelation that objective observation is a fictional/ideological construct followed the deprivileging of the faith of dynamics in an initiating and determining origin. In classical dynamics time can move backward without destroying the system. The origin is never lost; it haunts deterministic systems of thought because it remains theoretically reattainable. With the advent of thermodynamics in the nineteenth century, irreversible time became absolutely requisite. According to the Second Law of Thermodynamics, energy is inescapably lost in the universe. The world is running down, decaying, and every moment moves away from a receding origin:

> You cannot run the universe backward to make up for entropy. Events over the long term cannot replay themselves. And this means that there is a directionality or, as Eddington later called it, an 'arrow' in time. The whole universe is, in fact, aging. And,

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[7]Michio Kaku and Jennifer Trainer, *Beyond Einstein: The Cosmic Quest for the Theory of the Universe* (New York: Bantam, 1987) 50; and Laplace, qtd. in N. Katherine Hayles, *The Cosmic Web: Scientific Field Models & Literary Strategies in the 20th Century* (Ithaca: Cornell Univ. Press, 1984) 42.

in turn, if this is true, time is a one-way street. It is no longer reversible, but irreversible.[8]

Events move away from—or "forget"—previous states, just as the distribution of gases in a container reach a state of equilibrium through diffusion and, after a certain lapse of time, cannot reattain the original distribution; the gases cannot retrace the past because all "information" in the form of organization and order has been "forgotten." The origin is lost—caught, like the mythical position of the observer, in the chaotic fluctuations of nature.

The effect of entropy in general, then, is that as energy leaks from a system, order is lost and randomness proliferates. According to several recent theorists, however, such as Serres, Gleick, and Prigogine and Stengers, although entropy entails a transgression of lawful trajectories, it is not always "a downward slide toward disorganization" (Toffler xxi). The modern physics of chaos displaces both dynamic trajectories and the pessimism of an entropic universe moving inexorably to a homogeneous death. According to Serres, turbulence and sudden chaos "refus[e] enforced flow" (106), break the deterministic grip of physics that recognizes only laminar flow (the free fall of entropy) and/or linear trajectories:

> . . . the angle interrupts the stoic chain, breaks the foedera fati, the endless series of causes and reasons. It disturbs, in fact, the laws of nature. And from it, the arrival of life, of everything that breathes; and the leaping of horses.
>
> (99)

Chaos is possible in a world of entropy and therefore change; chaos, or turbulence, makes possible pockets of negentropy, of energy and flow, evolution and life—the forces opposed to static or determined equilibrium. According to Gleick, "where chaos begins, classical science stops" (Prigogine and Stengers 3). Chaos theory deliberately deals with "the demon of nonlinearity," with patterns that do not quite repeat but that escape entropy precisely because they are patterns (24). Chaos theory concerns itself with complexity and unpredictability, with discontinuity, bursts of noise, and Cantor dusts. It is a thoroughly non-Newtonian physics, of

which "the first message is disorder," in which origins cannot determine outcomes because they are forgotten (68). The observing scientist-god, outside the system and predicting/controlling with the useful tools of lawfulness and determinism, is an archaic fiction within the new narratives of chaos.

As the paradigms of determinism and objectivity have changed radically in science, similar reformulations have been made in the study of literature; deterministic structures in the form of linear narrative have begun to deconstruct themselves, and the possibility of objective transcription has been deprivileged. With the work of Joyce, Stein, and Woolf—the "high modernist" representatives—we see more and more often texts that resist and undermine traditional conventions of orderly construction. It is often noted that fragmentation and disjunction are the distinctive marks of modernist literature, but the implications of these distinctive features are rarely given the weight they deserve. The fragmentation of modern literature evidences the central ideological questions that writers of the early twentieth century could not escape or ignore: from what position can one speak with authority? what order can one attribute to existence? and how can one escape the authority of others who are speaking as if they are objective observers? Woolf's novels in particular stage the modernist debates between traditional conventions of narrative and these questions. In *Mrs. Dalloway*, Woolf struggles with the inconsistencies involved in decentering the objective narrator. The text questions the authority that inheres both in the construction of linear narrative and in the voice of an omniscient narrator, and this questioning forces the reader to think in the difficult and contradictory terms of a new way of speaking—one that enables communication but escapes totalizing meanings. The narrator of *Mrs. Dalloway* occupies the conventional position of observer-god—outside the system, able to see past, present, and future, able to control. She is even implicitly positioned as the originary condition of her characters' fictional existences. The contradictions inhering in the narrative structure of the novel, however, gradually deconstruct the narrator's status. Some characters seem to escape her knowledge and her control; others forget completely that their "origin" lies in her. The narrator gradually becomes caught up in the narrative, not only

unable to control its movement but inescapably involved in the seemingly chaotic fluctuations and de-formations of the text and of language.

The narrator as observer-god affects the text most forcefully through her "tunneling process." In Woolf's diaries written about the time she was working on *Mrs. Dalloway*, Hillis Miller has traced the notations concerning her "great discovery" of this process, a technique capable of endowing the narrator with the illusion of being the originating point and the determining force of all the characters: "'I dig out beautiful caves behind my characters: I think that gives exactly what I want: humanity, humour, depth. The idea is that the ideas shall connect.'"[9] These caves have a common origin, opening onto a "vast cavern" that is their source (183). The narrator, like the ideologically suspect deity of the dynamic paradigm, is this point of origination and control who determines the natural world of the text—the paths followed by "her" characters. As if subject to Newtonian physics and destined to reflect the narrator's control, the characters "tunnel" out from her in determined straight lines.

The most obvious method the narrator employs to demonstrate her control is endowing her characters with the ability to communicate extrasensorily, often without the benefit of language. Clarissa and Peter have a "queer power of communicating without words" (90). They are able to "go in and out of each other's minds without any effort" (94). Clarissa understands what Richard is trying to "say" when he gives her the roses, although he cannot bring himself to tell her: "She understood without his speaking, his Clarissa" (179). Language is unnecessary and fallible; the implication is that there is a deeper and truer source of ordered connection. According to Paul, Clarissa and Septimus "are united by an ability to connect in an inner world"; their unity suggests a hidden and mystified center or origin—inside, before, out of our view.[10] This type of omniscient narration creates an illusion that enables the reader to assume that an origin exists—identified with the narrator—that

guarantees pre-linguistic connection and full presence. We are invited to forget the material processes of language and the labor involved in narrative construction in favor of a Platonic inner vision that dispels the horror of chaotic divergence by promoting the sublimity of the same. Clarissa and Septimus merge into one character at the end, connected not through language, but extrasensory vision:

> He had killed himself—but how? . . . He had thrown himself from a window. Up had flashed the ground; through him, blundering, bruising, went the rusty spikes. There he lay with a thud, thud, thud in his brain, and then a suffocation of blackness.
>
> (280)

This is a heroic attempt on the part of the narrator to preserve the conventional narrative of the dynamic system. A dynamic system is conservative; energy cannot be lost from it because entropy and change disallow its deterministically motivated straight lines. The conventions of the omniscient narrator, taken to the extreme as they are in *Mrs. Dalloway*, tempt us to believe that Septimus's death has not brought entropy into the text because he and Clarissa have become one, their trajectories intersecting and paradoxically merging. The centrality of vision of omniscience, in contrast to the disorder of language, preserves the narrator's privileged position.

This visionary "immediate connection" between the characters is fostered by other means as well. Frequently, the characters are brought together, as if emanations of a single force, through common objects of perception. In the first few pages of the novel, the narrator presents the mysterious motorcar and the skywriting plane, both of which disrupt notions of individualized language and serve as the causal agents of group-think. Although the plane, for example, sets off different thoughts in Rezia and Septimus, old Mrs. Dempster and Maisie Johnson, the nursemaid, Mr. Bowley, Mrs. Bletchley, and Mrs. Coates, it serves as a focal point of common perception. The phenomenon of so many people entranced by the sight of a circling plane suggests a unifying force, just "outside" of our direct perception, that guides the characters to related actions and thoughts. Critics such as Hussey, Love, Moore, and Pankin who attempt to define this force, to locate an originary point for the narrative, must

[9]Qtd. in J. Hillis Miller, *Fiction and Repetition: Seven English Novels* (Cambridge, Mass: Harvard Univ. Press, 1982) 183.

[10]Janis M. Paul, *The Victorian Heritage of Virginia Woolf: The External World in Her Novels* (Norman, Okla: Pilgrim Books, 1987) 138.

invoke mystical definitions that border on religious dogma.[11] The search for determinate meaning, in this sense, is the quest for an origin that recedes from view.

The conventional omniscient narrative thus invites us to continue the metaphysical search for hidden order, and the text seeks authority for its narrative voice by conflating the invisible place of meaning with the position of the narrator. Symbols of connection, in this case, dovetail with symbols of the narrator's absent presence. We are inundated with misty images of unity that the characters, appropriately, commonly "see." Paul, Apter, and Miller, as well as countless other Woolf critics, have pointed out the striking similarities between the characters' internal pictures of trees and thread, unity and connection.[12] Clarissa sees an immortal part of herself "being laid out like a mist between the people she knew best, who lifted her on their branches as she had seen the trees lift the mist but it spread ever so far, her life, herself" (12). Moments of security in human companionship are "buds on the tree of life" (43). Lady Bruton sees Hugh Whitbread and Richard Dalloway "being attached to her by a thin thread" (170). Peter, snoring on a park bench, dreams of a comforting figure "made of sky and branches," a symbol of "myriads of things merged in one thing" (86).

The net, the strings, and the web all have their origin in the narrator's tunneling process. However, she mystifies the process of their production, creating the sense that they are archetypes arising from a collective unconscious "within" the novel. Many critics, from this sense of unity, have traced back to Virginia Woolf rather than to her constructed narrator a sermon or a creed and hence also a religion. These critics have granted Woolf the position of objectivity and control available to classical paradigms of science and eighteenth- and nineteenth-century theories of narrative, and consequently have granted her text a hidden metaphysical core of meaning. Significantly, unless we read Woolf as deconstructing the conventions of authoritarian representation, we will continue to recycle mythologies of objectivity and authorial intention, privileging the meaning and order that, in the early twentieth century, were being called into question.

In the system of inter-relationships that Woolf's narrator constructs, there is (almost) no escape from the networks of rank and repression—only a repetition of their rules, patterns of thought and action, common images and "stereotypes," just as in the deterministic paradigm effect follows cause with determinable predictability (122). It is a characteristic of linear systems that they will repress the contradictions inherent within them. Septimus's "difference" in *Mrs. Dalloway* is displaced by images of connection; they bind him inescapably to images of Evans' dead body and to a state of mind that makes him vulnerable to Bradshaw and Holmes and the forces of Religion. Septimus, like Serres, does not see "life" in equivalent trajectories that form a "stable tissue" or a "conjunctive network" (115). Within the conventional system of the novel, then, Septimus can be identified with the inescapability of noise, the ultimately undeniable presence of entropy—the desire for death.

Because the narrative structures its characters in this stable network to "reveal" a solid and unchanging relation to the same origin, the narrator is positioned to manipulate temporality; the narrative, like the dynamic paradigm of classical physics, can move backward in time. Woolf highlights problems of temporality in her narrative to make us aware of their ideological potential for institutionalizing methods of control. The narrator positions herself in a present tense, never overtly alluded to, which is located temporally ahead of any of the events or characters of the novel; the characters' actions and thoughts are told in the past tense, by a voice which must be located at a vantage point in the future. An example of both of these aspects of the omniscient narrator's voice is evident in Peter's walk through the park: "Clarissa refused me, he thought. He stood there thinking, Clarissa refused me" (74).

From her position outside the time of the text, the narrator can see the past, present, and theoretically the future of the characters; they are infinitely knowable because she holds the

[11]Mark Hussey, *The Singing of the Real World: The Philosophy of Virginia Woolf's Fiction* (Columbus: Ohio State Univ. Press, 1986); Jean O. Love, *Worlds in Consciousness: Mythopoetic Thought in the Novels of Virginia Woolf* (Berkeley: Univ. of California Press, 1970); Madeline Moore, *The Short Season between Two Silences: The Mystical and the Political in the Novels of Virginia Woolf* (Boston: Allen & Unwin, 1984); Shirley Pankin, *Virginia Woolf and the "Lust of Creation": A Psychoanalytic Exploration* (Albany, N.Y.: State Univ. of New York Press, 1987).

[12]T. E. Apter, *Virginia Woolf: A Study of Her Novels* (London and Basingstoke: The Macmillan Press, 1979) 52.

key to the Laplacean dream of atemporal omniscience, and control. One moment is very like another to her, and the time of the text is reversible. A mechanical paradigm makes possible a time frame like that of *Mrs. Dalloway*; past, present, and the narrator's "now" change places without distinct transitions, and little change is marked between the times: the narrator resists irrevocability and evolution. Miller has pointed out that on the first page of *Mrs. Dalloway* we are thrown into the narrator's sense of time's reversibility (185). The third paragraph is a flashback to Clarissa's days at Bourton when she was a young woman, but there are no time markers in the transition from the lived moment in which Clarissa is going to buy flowers to the remembered moment at Bourton: "And then, thought Clarissa Dalloway, what a morning—fresh as if issued to children on a beach." This is followed immediately by: "What a lark! What a plunge! For so it had always seemed to her, when, with a little squeak of the hinges, which she could hear now . . . " (3). Until given the parenthetical, "for a girl of eighteen as she then was," the reader is at a loss to untangle the different time periods, not yet knowing where in time to place scenes from Bourton. The narrator gives Clarissa the ability to go back into her own past as easily as she moves into her future. The past returns—one of the distinct characteristics of *Mrs. Dalloway*'s narrator.

The narrator does help out on the first page by using, although unobtrusively, the past perfect tense for the third sentence of the flashback. However, for the most part, the narrator abandons the device of tense distinction, using a single past tense for both narrative now and flashback. Time's direction becomes unclear; "eruptions from the past are congruent with associations concerning the present" (Pankin 120). Characters move in and out of the shared "tunnels" of their past. It is clear, for instance, that the past of Bourton and Clarissa's love for Sally Seton and refusal of Peter Walsh must remain in the past in order to serve a causal function, but this past, linked to the day of Clarissa's party, constantly irrupts into the present, usually without transition. Septimus can no longer distinguish whether time is moving forward or backward and sees the dead Evans among the trees of London:

The word "time" split its husk; poured its riches over him . . . an immortal ode to Time. He sang. Evans answered from behind the tree. The dead were in Thessaly, Evans sang, among the orchids.

(105)

Septimus believes that there is no death because in the world of the narrator's text things resist any essential change; they do not end. Death would be an escape from the origin, a change of state and form. The system the narrator constructs guarantees repetition; time moves, but states do not change. Rezia conjectures an overlapping of civilizations and eras within a present-day London: ". . . perhaps at midnight, when all boundaries are lost, the country reverts to its ancient shape, as the Romans saw it" (35). She desires and fantasizes the eternal return, the stability of reversible geometry, the primacy and determinancy of the origin.

At this moment, however, when we see how complete and airtight the narrator's Laplacean world is, we begin also to see it unravel in the face of a decentering tendency within the text—a tendency that springs from the same cultural matrix as twentieth-century paradigms of physics. A little more than halfway through the novel, the narrator steps out of the shadows, revealing that she, too, is a constructed character. She speaks out against the doctors Holmes and Bradshaw, whom Marcus has termed "social police," with their insufferable sense of divine proportion and conversion.[13] With this intrusion, the narrator sets into motion a doubling in the text that undercuts her position as the source of authority and control. A subversive, deconstructive tendency is built into the "deterministic" narrative. There from the start, this tendency is generally repressed by the regularity of the structure, but it is a mark of the "repressed" that it always returns.

The narrator's speech is anti-authoritarian; she is appalled by authoritarian worlds that disallow difference. She rejects the determinism of cause and effect and the demand for parallel or equivalent courses. Dr. Bradshaw makes it "impossible for the unfit to propogate their views until they, too [share] his sense of proportion" (150). He is allied with "Conversion," which insists that not only must all messages and lifestyles—courses—be the same but they

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[13]Jane Marcus, *Virginia Woolf and the Language of Patriarchy* (Bloomington, Ind.: Indiana Univ. Press, 1987) 103. See also *Virginia Woolf: A Feminist Slant*, ed. Jane Marcus (Lincoln: Univ. of Nebraska Press, 1983).

must all be her own message and course: "Conversion is her name and she feasts on the wills of the weakly, loving to impress, to impose, adoring her own features stamped on the face of the populace" (151). The authority of Dr. Bradshaw's Proportion and Conversion together create "Religion"—a deterministic, patriarchal religion. Its aim is to convert, to ensure that all springs from its law, to stamp its own face on rebellious segments of society; its spokesperson is Miss Kilman, named appropriately enough, to whom Clarissa has an absolute aversion. Religion and Miss Kilman would "destroy that, whatever it was, the privacy of the soul" (191-92).

Yet the narrator undermines her status as an "objective observer" in condemning Religion. It is the narrator who has invaded and destroyed the "privacy of the soul." Miller describes the narrator's invasive presence in terms used for rape:

> Though the characters are not aware of this narrating presence, they are at every moment possessed and known, in a sense violated, by an invisible mind, a mind more powerful than their own. This mind registers with infinite delicacy their every thought and steals their every secret.
>
> (178)

In her violent desire to observe her characters' interiors, however, the narrator is cheated; it has been she who has "stamped" her features "on the face of the populace" by constructing the system of the text around her position as observer and origin. She "observes" a solipsistic world of her own construction. At the same time that the solipsism of her narrative is revealed, the narrator's position as origin is undermined. The system of the text deconstructs itself; without an obvious pattern, the characters move away from the narrator's determination. *Mrs. Dalloway* becomes what Straub calls "double-voiced," a technique of speaking under erasure that undercuts the authoritative quality inherent in observation.[14] The goal is a new type of narrative that, in Ruotolo's words on Woolf, "collaborates in undercutting [the author's, or I would say narrator's] own design" of

authoritarianism.[15]

One of the greatest blows to the narrator's project is the fact that irreversible time enters her system near the end of the novel, enabling Lady Sally Rosseter, mother of five, to "forget her place," to escape her origin. The character of Lady Sally stands in opposition to the young Sally Seton, and the characters and the reader are forced to allow the notion of seemingly uncontrolled change into the narrative system. The other characters—Clarissa, Peter, Dalloway —have not created a disjunction with the past because they have not changed; they still carry on the same terms of relationship, and they all mentally move back and forth into and out of the same past. Lady Sally Rosseter's looks and personality are not at all what the rest of the characters have been imagining all day. Peter thinks, "Lord, Lord, what a change had come over her!" (284), and Clarissa is completely taken aback:

> Sally Seton! after all these years! She loomed through a mist. For she hadn't looked like THAT, Sally Seton, when Clarissa grasped the hot water can, to think of her under this roof, under this roof! Not like that! . . . One might put down the hot water can quite composedly. The lustre was gone out of her.
>
> (260)

The narrator has been using the preserved memory of Bourton and Sally Seton as the locus of communal memory, of which she is the actual source. She can then create a sense of time that is solid and reversible by interchanging the memories of Bourton with the lived present. For the bulk of the novel, historical movement and change have vanished in order that time can be conceived of mechanically, as if reversible and continuous, as if originary points continue always to determine the present and are never forgotten. What Sally Seton does at Clarissa's party is disentangle herself from a determining past; she forgets and thereby imposes an irreversibility and a new type of narrative

[14]Kristina Straub, "Women, Gender, and Criticism," in *Literary Criticism and Theory: The Greeks to the Present*, eds. Robert Con Davis and Laurie Finke (New York: Longman, 1989) 855-76.

[15]Lucio Ruotolo, *The Interrupted Moment* (Palo Alto: Stanford Univ. Press, 1987) 7. There are, of course, the familiar thematic threads to trace: "the emptiness at the heart of life" (45) and the gulf that there must be between people (181). Hussey's *The Singing of the Real World* traces these themes, and Ruotolo's work on interruption in Woolf's work is applicable. For brevity's sake I will study instead the points at which the narrative function is undercut.

sequence. The geometry of straight lines and determined paths, to use Serres' terminology, is disrupted, its destruction embodied in Sally's transformation—the irreversible transformation of energy.

Significantly, as Sally Rosseter escapes the narrator's determining memory—and control—she also escapes the structure of narrative omniscience, undermining the narrator's status as objective observer. The narrator has very limited access to Sally's mind, unless it is through external dialogue; Sally's thoughts are apparently closed to her. Sally denies narrative omniscience, and this is part of the reason that she creates such a disruptive difference for characters and reader alike when she arrives at the party. Undetermined and unknowable, she disrupts the narrative structure of the novel. Knowing and controlling are revealed to be interconnected attributes of the narrator. Her knowledge has gained her control over what she already knows. Without knowledge she has no control, but without control she has no knowledge. We see clearly how the position of the objective observer can be undermined by inconsistencies that deterministic systems repress.

Another character who denies the narrator omniscience is Clarissa Dalloway's neighbor, a figure appropriately highlighted, as Sally is, by symbolic overtones. Because the narrator does not have access to the old woman's thoughts, she cannot bring her into the narrative system she has been trying to establish. The sense created is one of disjunction, even disruption. Clarissa sees the neighbor as the embodiment of the privacy and independence that "Religion" would subdue and destroy:

> Let her climb upstairs if she wanted to; let her stop; then let her, as Clarissa had often seen her, gain her bedroom, part her curtains, and disappear again into the background. Somehow one respected that. . . . There was something solemn in it—but love and religion would destroy that, whatever it was, the privacy of the soul.
>
> (191-92)

The neighbor withdraws into darkness, out of Clarissa's and the narrator's view and control. She can only be narrated—subjected to patterning and determining—in the moments when she chooses, in a sense, to be seen. The neighbor is not violated nor made to conform;

she is left alone, immeasurable, following patterns of her own that we cannot, literally, precisely know.[16] She affirms the mystery of self-organizing integrity that we still face in this decade: "here was one room, there another. Did religion solve that, or love?" (193).

We can see generalized disruptions as well toward the end of the novel when the decentering tendency that denies the narrator's omniscience disrupts the linear system of the "tunneling process." Some of the most grimly humorous moments of the novel are the points at which the characters' extra-sensory perception goes awry. At one point in the novel Rezia and Septimus sit together in Regent's park, Septimus having the revelation that there is no death, seeing Evans (actually Peter Walsh) emerging from behind a tree, and Rezia seeing her world fall apart, her home lost, her husband mad. The scene is, on one level, tragic and desperate. Septimus heroically tries to stand up as he sees Evans/Peter approaching: "I must tell the whole world, Septimus cried, raising his hand (as the dead man in the grey suit came nearer), raising his hand like some colossal figure who has lamented the fate of man for ages in the desert alone. . . ." Rezia becomes more desperate: "'But I am so unhappy, Septimus,' said Rezia trying to make him sit down." And through this scene comes Peter: "[a]nd that is being young, Peter Walsh thought as he passed them . . . lovers squabbling under a tree; the domestic family life in the parks" (106-7). The characters exemplify the fallacy of objective analysis, revealing how one is always tangled up in and constructing the "objects" one views. At the same time, the fact that the characters are not thinking coherently anymore reveals how little validity causal theory has in the context of a material universe. Ironic disjunction reigns—turbulence in the narrative system.

I mentioned above that the narrative system attempts to incorporate Septimus's suicide, but that in this attempt it fails. He remains, in context, the central image of escape from the deterministic framework—particularly when Peter hears the ambulance in which Septimus's mangled body is being borne away. Septimus has plunged to his death in a last attempt to

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[16]Ruotolo argues that Clarissa Dalloway generally possesses this ability to remain "disinterested," to allow "what is other to remain so—to connect without imposing." He relates this trait to Keats' "negative capability" (112).

escape the forces of "Proportion" and "Conversion," the "social police," those who "make life intolerable . . . forcing your soul" (281). If Clarissa's judgment is to be trusted, Septimus's death should be seen as a tragic but triumphantly defiant ("I'll give it you!") attempt to elude the forces of control in order to preserve "the privacy of the soul," "his treasure" (281). Septimus recognizes that the "spaces between [sounds] were as significant as the sounds" (33), that places not determined, not already filled and patterned and violated by language, have a disruptive and anarchistic worth, so it is only appropriate that Woolf should allow him to be the one to jump beyond the outstretched fingers not only of Bradshaw and Holmes but of the narrator herself. He becomes the double voice of Woolf's narrative that paradoxically disrupts "narrative." He is removed to an inviolable silence, and the narrator is left with a gaping hole in her network. Peter Walsh represents this sense of disjunction and irony as he listens to the sound of Septimus's ambulance siren:

> One of the triumphs of civilization, Peter Walsh thought . . . . Swiftly, cleanly the ambulance sped to the hospital, having picked up instantly, humanely, some poor devil . . . . That was civilization . . . the efficiency, the organization, the communal spirit of London.
>
> (229)

The juxtaposition of Septimus's suicide and Peter's complacencies is striking in its refusal to be contained within the narrative tunneling process. Septimus symbolizes the force that breaks the narrative system.

It is significant that the novel ends with Clarissa's sensing Septimus's death, and it is appropriate that the old woman next door should be involved. In one room is the party, ruled by the authoritarian voice of the narrator. In the other room is Clarissa and the two figures who have disavowed the possibility of the omniscient observer. The two rooms each demand that the other room does not exist, but Woolf has constructed a text in which both voices speak at once—the voice of determinancy and omniscience and the voice of rebellious chaos. And true to what I think was Woolf's commitment to a double-voiced text which would undercut any final and mysterious originating authority, she refuses finally to obliterate either one: "here was one room, there another. Did religion solve that, or love?" (193). She recognizes the fallacy of man/woman observing, aware that one colors everything one sees, and aware that "there is a spot the size of a shilling at the back of the head which one can never see for oneself."[17] She marks a point in the twentieth century, then, when the inconsistencies Newton had seen within dynamics were again surfacing, but the alternative paradigm did not yet exist, and Newton's God was not intervening to set the system to rights, and so the narratives of the time entertained the project of a continual construction and deconstruction of order. All that could be done was to reject repeatedly the siren that seduced one to hunt for that place of pure self presence, the pure origin—all of the chimera that metaphysics had invented to support the possibility of the objective observer—the little god who is man. Woolf suggests the possibility of a "turbulent" narrative—a narrative that reminds itself constantly of its own shortcomings and illusions.□

[17]Virgina Woolf, *A Room of One's Own* (New York: Harcourt, Brace, Jovanovich, 1957) 94.

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THE SCIENTIFIC TEXT AS LITERARY ARTIFACT:
READING MAX PLANCK

The notion is still widely accepted, particularly among practitioners of science, that in scientific writing we find a literal, transparent language, devoid of ambiguity, conveying one clear meaning and representing directly the "facts" observed.[1] Even Jacques Derrida, whose convictions would situate him at the opposite end from most scientists in any spectrum of theories, has accepted the prevailing self-assessment by many scientists of their texts and bracketed scientific language from his deconstructive readings.[2] Other investigators note, however, that language is not divided into the figural and the literal, but is inevitably rhetorical, functioning as metaphor, with only an arbitrary and conventional relation to whatever it has been assigned to signify. Contradiction, ambiguity, self-referentiality, multiple meanings beyond those ever possible in the mind or intentionality of one author or one reader—these self-subverting qualities inhere in language. Thus even within stringent disciplinary confines, description itself is always contingent upon and undermined by the natural language in which it is written.

In the context of this view of language I have chosen to examine texts that are canonical in the history of theoretical physics. My readings of Max Planck's papers rest on several assumptions. One is that the historical contingency of the notion of a literal language has been revealed in studies of its theological origins and its evolution as a function of social and cultural forces and the self-interest of the scientific community.[3] The idea that there is a privileged "language of Nature" readable only by mathematically qualified scientists originates with Galileo, but is connected to even earlier convictions that interpreting the Bible means deciphering the language of God. In our time theoretical physicist and Nobel Laureate Richard Feynman has been quoted as saying: "If you want to learn about nature, to appreciate nature, it is necessary to understand the language that she speaks in. . . . She offers her information only in one form. . . ."[4]

Contrary to Feynman (as representative of authoritative opinion) I would argue that we do not learn any so-called language of a gendered nature, but rather we bring our own languages to readings of the world that depend upon and can only be couched in terms of the peculiar grammar and syntax of our languages. These are presumptions like those of Benjamin Whorf who argued for the inescapable determining power of language over all its users, and thus the dependence of scientific description and interpretation upon the patterns and peculiarities of a natural language. In a contemporary Whorfian analysis of "physics as language," Bruce Gregory, of the Harvard-Smithsonian Center for Astrophysics, quotes Niels Bohr's remark that "[p]hysics concerns only what we can *say* about nature."[5] In agreement with Bohr, Gregory writes: "Position and motion do not seem to be properties of the subatomic world; they seem to be our way of *talking* about the subatomic world" (94). "[T]he way we divide the world in language tells us

[1] A version of this essay has been published in my book *Transgressive Readings: The Texts of Franz Kafka and Max Planck* (Ann Arbor: Univ. of Michigan Press, 1990).

[2] Derrida makes the distinction, for example, in an essay on Kafka's parable "Before the Law": "This, perhaps, is where literature begins. A text of philosophy, science, or history, conveying knowledge or information, would not give up a name to a state of not-knowing" ("Devant la Loi," trans. Avital Ronell, in *Kafka and the Contemporary Critical Performance*, ed. Alan Udoff [Bloomington: Indiana Univ. Press, 1987] 142).

[3] Among the many studies on this subject are Y. Elkana, "The Historical Roots of Modern Physics," in *Proceedings of the International School of Physics, "Enrico Fermi": History of Twentieth Century Physics*, ed. C. Weiner (New York: Academic Press, 1977); and Robert M. Markley, "Objectivity as Ideology: Boyle, Newton and the Languages of Science," *Genre* 16 (Winter 1983): 355-72.

[4] The obituary for Feynman in the *New York Times* 17 Feb. 1988: 21.

how we think the world is 'really' put together" (174). Thus, whatever the discourse, "[t]he minute we begin to talk about this [everyday] world . . . it somehow becomes transformed into another world, an interpreted world, a world delimited by language" (183).

The argument has been advanced by Richard Rorty, among others, that science only defines itself as science once it has been accepted and transmitted in language. On the basis of this view, it is justifiable to examine science as it is realized in the texts that convey it to peers for ultimate legitimation or rejection. For texts to be rejected by the relevant community of scientists means that they will be excluded from the body of accepted scientific "facts." For the texts to be accepted means they become "science," sources of established "facts," potential makers of Nobel Laureates, and sources of further legitimizing activities as they are cited by subsequent investigators.[6]

There are several reasons why one would turn to texts written by the "father of quantum physics" as exemplary scientific texts on which to test the idea that language lends itself to creating meanings beyond the ostensible ones in any given text. Max Planck's writings can be considered canonical for his time, since they were produced by a quintessential insider to the scientific enterprise who was the preeminent leader of the scientific establishment during the era in which quantum physics and before that theoretical physics itself were born. Planck (1858-1947) was, among other things, Rector of the University of Berlin, Secretary of the Mathematical-Physical Section of the Prussian Academy of Sciences, President of the Kaiser Wilhelm Society, Nobel Laureate in physics, first patron of Einstein, and profoundly influential teacher, administrator, editor, lecturer, and writer. From one perspective it is ironic that Planck, pillar of the scientific establishment, German patriot and monarchist, upholder of the political status quo, classified by historians and commentators as conservative, was the scientist whose work initiated a revolution, marking the end of the era of classical physics and the beginning of the new era of quantum physics.[7]

In December of 1900 Planck read to the German Physical Society in Berlin a paper which presented the latest results of his theoretical research on the spectral distribution of radiation emitted from the walls of a hollow enclosure (called a "black body") when that enclosure is heated to various temperatures.[8] Of this event it has been written that "[i]n December 1900 the German physicist Max Planck ushered in the twentieth century" (Gregory 74). While addressing and attempting to solve an unsolved problem of nineteenth-century physics, Planck proposed a mathematical solution that led to the notion that radiation (that is, energy) was emitted and absorbed not continuously but in discrete units which he called quanta. The consequence, apparently unrecognized by Planck himself and certainly by other physicists until some years later, was the introduction of a new view of reality. In physics, but also in philosophy it had been considered axiomatic that Nature never makes jumps; energy and light, for example, and thus motion and matter were continuous, just as they appear to the naked eye. Continuity is equivalent to strict determinism. Once it began to be recognized, after 1906, that Planck's work had provided proof of discontinuity, that recognition gave rise eventually to uncertainty that shook the foundations not only of physics, but by implication also of metaphysics.

[5]Gregory, *Inventing Reality. Physics as Language* (New York: Wiley, 1988) 95.

[6]The notion that "facts" are created in the process of legitimizing scientific texts is from Bruno Latour, *Science in Action* (Cambridge, Mass.: Harvard Univ. Press, 1987), but also goes back to the work of Ludwik Fleck in *Genesis and Development of a Scientific Fact*, rtp. of 1935 ed., trans. Fred Bradley and Thaddeus J. Trenn (Chicago: Univ. of Chicago Press, 1979). I also relativize the term "facts" because of their inevitable theory-ladenness. The only "facts" that will be found and labeled as such are those that a particular theoretical net will catch, just as we are only able to see what we have focused on and comprehend what we are prepared to comprehend. See, for example, Harold I. Brown, *Perception, Theory and Commitment. The New Philosophy of Science* (Chicago: Univ. of Chicago Press, 1979)

[7]A recent biography of Planck is John L. Heilbron's *The Dilemmas of an Upright Man. Max Planck as Spokesman for German Science* (Berkeley: Univ. of California Press, 1986).

[8]"Zur Theorie des Gesetzes der Energieverteilung im Normalspectrum," in *Physikalische Abhandlungen und Vorträge* (Braunschweig: Vieweg, 1985) 1: 698-706. Future references to this three-volume set of Planck's papers and lectures will be abbreviated as *PAV* with volume and page number; translations are mine. An English translation of Planck's Dec. 1900 paper—"On the theory of the energy distribution law of the normal spectrum"—has been published in *Planck's Original Papers in Quantum Physics*, trans. D. ter Haar and Stephen G. Brush, ed. Hans Kangro (London: Taylor and Francis, 1972) 38-45.

There is no doubt that it was an event of the first order, comparable with the scientific revolutions brought about by Galileo and Newton, Faraday and Maxwell. Like these it has changed the whole aspect of physics and deeply influenced all neighboring sciences, from chemistry to biology. Its philosophical implications reach far beyond the epistemology of science itself into the deepest roots of metaphysics.[9]

By the end of the 1920s, through the work of Einstein, Bohr, Heisenberg, and others, the discovery had led to a deciphering of the structure of the atom.

We would expect texts with such momentous consequences to have become canonical in the history of science, as indeed has been the case with Planck's 1900 papers introducing the quantum. We are alerted, however, to the possible problematic nature of reading Planck's texts by multiple, conflicting readings by historians and philosophers of science of those very papers. Were their language "literal," or transparent, we would not have the dispute between Thomas S. Kuhn's revisionist reading and readings by his predecessors, among whom I mention only one leading interpreter of Planck, Martin J. Klein, as representative.[10] Kuhn moves the revolution that introduced discontinuity from 1900 to 1906, finding it not in the work of Planck, but in Einstein's interpretation of the quantum. That Planck's papers of 1900 were not generally understood by physicists for nearly ten years after their publication can be attributed to lack of clarity in Planck's formulations (Kuhn), but also, as Klein does, to the fact that at the time the attention of physicists was not directed toward the theory of radiation, but toward other more exciting contemporary events—the discoveries of radioactivity, of the electron, and of radium, among others. In addition, Klein points out that scientific thought was powerfully influenced by anti-atomists Ostwald and Mach who attacked Boltzmann's work on which Planck's depended. That is, all kinds of political, social, and linguistic factors can determine misreadings. When Kuhn presented his revisionist views on Planck at a centennial symposium in honor of Einstein, they evoked an emotional rather than a reasoned response in defense of Planck by members of an audience of physicists and historians of science.[11] In an afterword to his book, Kuhn quotes a published report of the meeting which again misreads the Planck story. We are all practitioners of more or less creative misreading, and the story of Planck-interpretations indicates that scientific development can also be narrated as a story of misreading. We can be considered to be part of an historical continuum of inevitable misreadings even as we venture beyond the confines of the disciplines that have legitimized the readings of Planck's texts.

I continue the history of "misreadings" of Planck by taking reading a step beyond the premises mentioned above to find a subversive potential in Planck's texts. By abandoning exclusively literary terms of analysis as well as an exclusively scientific metalanguage in favor of cross-disciplinary terminology, I have been led to find in Planck's work an extra-scientific narrative that has multiple connections to the ostensible, theoretical-physical narrative. We are reminded by Gillian Beer that "the nature of discovery may be predetermined by the conditions for its description."[12] When we are guided by a literary metalanguage, we tend to make literary discoveries in a text; a scientific metalanguage leads to scientific discoveries. Disciplinary discourse sets parameters and limits and tends to do our thinking for us. When I read Planck's papers for their literary-rhetorical features I find hyperboles, personifications, chiastic reversals, and metaphors that drive the scientific agenda. Hyperbole is common, such as the term "ungeheuer," which can mean "enormous," "immense," "huge," "vast," "colossal,"

[9]Max Born, "Max Karl Ernst Ludwig Planck," *Obituary Notices of Fellows of the Royal Society* 6 (1948): 161-80, rpt. in *The World of the Atom*, eds. Henry A. Boorse and Lloyd Motz (New York: Basic Books, 1966) 1: 462.

[10]Thomas S. Kuhn, *Black-Body Theory and the Quantum Discontinuity, 1894-1912*, rpt. of 1978 ed. with new afterword (Chicago: Univ. of Chicago Press, 1987). Key articles by Klein are: "Planck, Entropy, and Quanta, 1901-1906," *The Natural Philosopher I* (New York: Blaisdell, 1963); "Thermodynamics and Quanta in Planck's Work," *Physics Today* 19.11 (Nov. 1966): 23-32; and "Max Planck and the Beginnings of the Quantum Theory," *Archive for History of the Exact Sciences* 1.1 (Sept. 1960): 459-79.

[11]In Harry Woolf, ed., *Some Strangeness in the Proportion: A Centennial Symposium to Celebrate the Achievements of Albert Einstein* (Reading, Mass.: Addison-Wesley, 1980) 194-95.

[12]"Problems of Description in the Language of Discovery," in *One Culture. Essays in Science and Literature*, ed. George Levine (Madison, Wis.: Univ. of Wisconsin Press, 1987) 46.

"tremendous," or "terrific." Paradoxes lurk within the scientific description such as, for example, the phrases "relatively completely insignificant," or "relatively enormous" (*PAV* 2: 253). Planck prefers certain metaphors; for example, he equates physics, in particular its canonical theories, with an edifice on strong foundations that can only be shaken by heavy artillery (meaning powerful new hypotheses). The metaphor of the building or edifice of science remains in common use today. Anthropomorphic relations are expressed in such terms as "satisfactory" which is the primary criterion for the acceptability of an hypothesis or theory. (This is despite the fact that in his essays Planck asserted that scientific progress depends upon the emancipation of science from anthropomorphisms. Apparently he was not thinking of his own scientific rhetoric.) Related to these are personifications, for example, the language used to describe the action of an oscillater (the imaginary, microscopic element which transmits the radiation in a black body): it is "capable of accomplishing" something; it can be "hindered"; it "needs" something; it "takes possession" of something (*PAV* 2: 253).

Rhetorical gestures of inclusion—such as "we imagine," "our next task," and "we want to"—insure reader involvement in the stages of the investigation. The effort is presented as a cooperative one between two equal investigators —author and reader. A personal narrator is consistently present in Planck's texts. Among the terms that are laden with value by their repetition in contexts that assume the reader's complicity and support are "meaning," "knowledge," "unity" and "simplicity" (referring to hypotheses or theories, or the physical "world-picture" in general), "future," and "further development." Of such terms one that bears a particularly heavy burden of meaning is "experience"—a fluid metaphysical category. Paul K. Feyerabend writes about the tradition of "experience" in physics:

> . . . a never examined, mystical and stable entity. . . . All that is known about experience is that it is something that springs to the eye, that it is a 'divine illumination' this time not by God, and not through the mind, but by Nature, and through the senses; and which guarantees success. . . . Nor are we able to determine what experience *tells us*. Experience taken by itself is mute. It does not provide any

means of establishing a connection with language. . . . [13]

Many of these features of Planck's writing are inherent in the nature of scientific language itself. In scientific and mathematical papers today it is common to find hypotheses, theories, or proofs characterized as "rich," "powerful," or "elegant," making them hardly distinguishable from a late model sports car or investment broker. Language replete with aesthetic, metaphysical, or "subjective" implications supports a value-charged text; we must acknowledge that a scientific text is loaded with extra-scientific meaning.

It is in the nature of the theoretical-physical paper to require a "willing suspension of disbelief" (Coleridge) for entry into the world of black-body radiation. Since the black body exists only as a construct of the theoretical physicist's imagination, we are required to picture in our minds a fictional drama originating in the premises of a fairy-tale world. By 1911 Planck's thought-experimental procedure was so generally known that he could treat it as a familiar trope: "Let us imagine, in the familiar manner, a spatially wide-expanded vacuum, filled with stationary black radiation and bordered by reflecting walls, and resting in that vacuum, at appropriate distances from each other, a large number N of linear, homogeneous oscillators absorbing and emitting radiation with the frequency v. . . ."[14] Having willingly entered the "magic circle," we find there multiple narrative perspectives (e.g., Planck proposes the alternate interpretations of an "electrodynamic observer" or a "thermodynamic observer"), and arbitrariness of naming ("let us call it," and "let this stand for"—in the case of a mathematical symbol).[15]

We also find that it is possible to read theoretical physical stories as literary, social, political, or other kinds of narratives. For example, Planck's paper for the 1911 Solvay Congress—the first international conference on theoretical physics—can be read as a drama of fall and partial redemption in which an heroic

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[13]"On the Improvement of the Sciences and the Arts, and the Possible Identity of the Two," *Boston Studies in the Philosophy of Science*, eds. Robert S. Cohen and Marx W. Wartofsky (Dordrecht, Holland: Reidel, 1967) 3: 405, 398, 395.

[14]"On the Hypothesis of Quantum Emission," (1911) *PAV* 2: 261.

struggle takes place between a protagonist (Planck's latest quantum hypothesis) and opposing forces which are conquered one by one.[16] Bruno Latour writes of such dramas:

> The more we get into the niceties of the scientific literature, the more extraordinary it becomes. It is now a real opera. Crowds of people are mobilised by the references; from offstage hundreds of accessories are brought in. Imaginary readers are conjured up which are not asked only to believe the author but to spell out which sort of tortures, ordeals and trials the heroes should undergo before being recognised as such. Then the text unfolds the dramatic story of these trials. Indeed, the heroes triumph over all the powers of darkness, like the Prince in *The Magic Flute*. The author adds more and more impossible trials just, it seems, for the pleasure of watching the hero overcome them. The authors challenge the audience and their heroes sending a new bad guy, a storm, a devil, a curse, a dragon, and the heroes fight them. At the end, the readers, ashamed of their former doubts, have to accept the author's claim. These operas unfold thousands of times in the pages of *Nature* or the *Physical Review.* . . .
>
> (53-54)

Many tales can be told by one narrative and shared by science and literature. By the same token, language, irrespective of discipline or topic, entails the possiblity of telling the same story in many equal discourses.

Generally speaking, in the opening paragraphs of a paper, Planck marshals the familiar devices of rhetorical persuasion to convince readers of the importance of a discovery, its firm grounding in the context of accepted physical problems and previous results, and of the necessarily limited nature of the task the author has set himself within the bounds of a particular paper. A political agenda may become apparent through such designations as "radical" (for Einstein's theoretical position, for example) or "absolutely conservative" (applied to British physicist James Jeans) for opposing theories, thereby situating Planck himself in the desirable moderate or middle position—comparable to his standpoint in the spectrum of German politics.[17] But Planck's political-rhetorical claim to the scientific middle-of-the-road, for which he is known, is contradicted by other textual operations that reveal him to be actually engaged in a pattern of oscillation—not situated at mid-point but containing within his language unresolved dichotomies. Beyond its use by Planck, the term "oscillation" serves as a cross-disciplinary description. It occurs in biological, chemical, mathematical, and engineering descriptions, describes behavior in electric currents and in animate as well as inanimate matter, and can describe reading and textual logic.

In 1913 the second edition of Planck's *Lectures on the Theory of Heat Radiation* was published. In his preface the English translator wrote of the importance of this standard text: "Probably no single book since the appearance of Clerk Maxwell's *Electricity and Magnetism* has had a deeper influence on the development of physical theories."[18] It is not exaggerated to claim for the *Lectures* the status of an exemplary scientific text for its time. Planck's Foreword emphasizes his so-called second quantum hypothesis and situates the author, in the familiar manner, midway between those physicists who reject his views on the quantum for "conservative reasons," and those who believe they must add "yet more radical assumptions."[19] The cautious "standpoint" which the revised edition represents is anchored to classical authority, with the proviso that transgression, if absolutely necessary, is an option:

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[15]In an 1889 lecture Heinrich Hertz said of a fundamental electrodynamic law: "Whatever one may think about the correctness of this [law], the totality of efforts of this kind constitutes a closed system full of scientific appeal; once you had wandered into its magic circle you remained imprisoned in it." ("Über die Beziehungen zwischen Licht und Elektricität," address at the 1889 meeting of the German Association, rpt. in Hertz, *Gesammelte Werke* 1: 339-54, on 342. Qtd. in Christa Jungnickel and Russell McCormmach, *Intellectual Mastery of Nature. Theoretical Physics from Ohm to Einstein* [Chicago: Univ. of Chicago Press, 1986] 2: 90, n. 81.)

[16]"The Laws of Thermal Radiation and the Hypothesis of the Elementary Quantum of Action," "Die Gesetze der Wärmestrahlung und die Hypothese der elementaren Wirkungsquanten" (*PAV* 2: 269-86).

[17]These terms indicate an unstated political agenda in Planck's 1910 paper "On the Theory of Thermal Radiation" (*PAV* 2: 237-47).

[18]*The Theory of Heat Radiation*, authorized trans. by Morton Masius, rpt. of 1914 English ed. (New York: Dover, 1959) v. The German original is *Vorlesungen über die Theorie der Wärmestrahlung*, 2nd rev. ed. (Leipzig: Johann Ambrosius Barth, 1913) page references are to the German text.

Since nothing is more disadvantageous to the successful development of a new hypothesis than exceeding its boundaries, I have always advocated making as close a connection as possible between the quantum hypothesis and classical dynamics, and only violating the limits of the latter when the facts of experience leave no other way out.

(viii)

Planck's critique of his first edition includes the speculation that it must have left the reader feeling dissatisfied, a situation he has tried to avoid by insuring complete internal consistency of the theory presented in the second edition, though he certainly does not want to claim that it does not need further improvement. We see here several of Planck's typical devices: the reference to his reader, and the expressed confidence in his own theories combined with a modesty disclaimer. They are followed again, in Planck's typical rhetorical mode, by an offensive strategy. We must look closely at the offensive paragraph to see an example of Planck's rhetorical and logical procedures and to find an unacknowledged contradiction between conformity and subversion which suggests an option different from Planck's claim to the middle and to the naming of Planck as "conservative."

Before presenting the paragraph in question let me point out that it has six main segments, arranged like the skins of an onion—the outermost "skins" (at the opening and conclusion of the paragraph) serve to connect to the preceding and subsequent paragraphs and are the most pronouncedly rhetorical or narrative. The four interior "skins" form a chiasmus—a cross-disciplinary pattern to be found here and there throughout the *Lectures*. In a rhetorical or literary context the chiasmus is a logically structured trope consisting of "the inversion of the order of syntactical elements in the second of two juxtaposed and syntactically parallel phrases or clauses."[20] Beyond linearity, the chiasmus describes a diagonal cross. On the level of simple engineering the diagonal cross supplies structural support for scaffolding. There is evidence that chiasmus is a pattern with roots deep in the mind or experience. A study of

children's first drawings showed that a diagonal cross is one of the six basic diagrams they use.[21] In genetics the chiasmata are sites on a chromosome where genes are transposed—a process upon which the genetic diversity of life forms depends. Not only our genetic makeup but our vision and thus our perception of the world depend upon the chiasmus. The optic chiasm is the site where the optic nerve fibers from half of each retina cross, combining the two fields of vision and making perception of whole objects possible. By proposing such a description, therefore, we are defying the usual disciplinary boundaries of description.

The core of the paragraph in question is a statement about laws and models that reverses Planck's political self-positioning in this book and his papers. In addition to being a contradiction, it is also a riddle and a paradox that denies the representational nature of scientific language.

> Thus, while the new edition of this book may not claim to bring the theory of heat radiation to a conclusion that is satisfactory in all respects [or: satisfactory to everybody], this deficiency will not be of decisive importance in judging the theory. For anyone who wanted to make his attitude concerning the quantum hypothesis depend, for example, upon whether the meaning of the quantum of action for elementary physical processes is made clear in every respect or can be visualized through a simple dynamic model, misjudges, I believe, the character and the meaning of the quantum hypothesis. *A really new principle does not allow itself to be expressed via a model that functions according to old laws.* And with regard to the ultimate formulation of the hypothesis, one should not forget that even from the classical point of view the physics of the atom has always remained in reality a thoroughly dark, inaccessible region into which the only introduction of the elementary quantum of action promises to cast some light.

(ix; emphasis mine)

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[19]The second quantum hypothesis proposed the quantum discontinuity only during the *emission* of radiation, not during absorption which proceeded continuously according to classical laws.

[20]*Webster's Third New International Dictionary.*

[21]Desmond Morris, *The Biology of Art. A Study of the Picture-Making Behavior of the Great Apes and Its Relationship to Human Art* (New York: Knopf, 1962).

An intrepid explorer with flashlight (the quantum casts *and* explains light, although it remains itself partially in darkness) dares to enter uncharted territory despite the objections of the faint at heart and petty in spirit who will not be satisfied until they see a precise map of the route. This is hardly the self-portrait of a conservative, as Planck is consistently referred to in the literature. For this endeavor, a kind of faith is required—faith in "character" and "meaning." That character and meaning is contained in the core sentence of the paragraph: *not* a dichotomy between new principle and old laws, but—separated from that direct confrontation by three layers of interference— the rejection of *representation* (or "expression"— from the verb "wiedergeben") that depends upon a model that functions according to old laws. Representation, functioning, and modeling come between new principle and old laws, and thereby indicate how far distant "laws" can be from interrogation, challenge, change. The distance is so great that the laws *appear* immutable ("old," i.e., permanent). The distance appears so great that stages of knowing— representation, functioning, modeling—do *not* work to overcome it. What *does* work we are not told, only what does not work. How, or whether, a really new principle is to be represented (if not by a functioning model, if not by a model functioning according to old laws) is not indicated.

The conundrum of the laws is embedded in that subersive trope the chiasmus: the benighted make their judgment dependent upon a) meaning that is clear in every respect; b) a model. The response follows that b) the kind of model they want cannot be expected to do the job; a) clarity of meaning in the form of a final formulation is not available in territory that is generally acknowledged to be shrouded in mystery.

What could be more non-scientific?—self-contradiction, the denial of direct representation, the inaccessibility and apparent immutability of the old laws, their distance from new thought, the impossibility of clear meaning and final formulations, a protagonist with benighted opponents, dark, trackless territory.

Planck does not always follow the subversive convolutions of the chiasmus. The *Lectures* often progress by means of more conventional patterns—linear arguments that begin with a general assertion, then bifurcate into smaller subunits as the assertion is broken into its individual parts for proof; passages that accumulate assertions to arrive at a definition; or frequent back references to supporting material in previous sections and anticipatory references to the arguments yet to come.

There is in general a dialogue in Planck's texts between certainty, the side where definitions are unequivocal, where "the absolute" exists, "all . . . questions are answered," conclusions and confirmations "follow with necessity," there is "complete agreement," and "all details are known," in alternation with a language of qualifiers and the admission that what the narrator has described "will only approximate the actual conditions," or that the central definition—the definition of a black body— defines something which does not exist. As in a nonscientific text, you can find hesitations, qualifications, logical reversals, and deep recursive boxes that undermine any appearance of direct reference.

Planck describes, self-reflexively, congruence between language and the processes it wants to describe: "This complicated method of consideration lies wholly in the nature of the case and corresponds to the complexity of the physical processes in a medium irradiated in such a manner" (96). This confidence in the representational nature of language is undermined, however, by Planck's own evidence for the problematic nature of representation. He challenges his statement by a practice of linguistic qualifications that carry his discourse multiple degrees of distance away from representation as he describes it. We can examine a paradigmatic section of the *Lectures*. It follows one of Planck's important contributions to physical theory—his definition of entropy. He explains that there is no point in trying to provide rigorous (mathematical) proof of the definition, since "probability" (on which a definition of entropy depends) is still lacking a quantitative definition.

> One could even perhaps suspect at first glance that for this reason the proposition has no definite physical meaning at all. It may, nevertheless, be shown by a simple deduction that—even without considering more closely the concept of the probability of a state—one is in a position just on the basis of the above proposition to determine quite generally the way in which entropy depends on probability.
>
> (116)

A translation that foregrounds the language of this segment produces an awkward English version. That is because of the necessity of conveying the many qualifications that carry this discourse multiple degrees of distance away from representation as Planck describes it. The passage begins with a subjunctive verb ("könnte"), setting up a contrary to fact situation. It continues with "even" ("sogar"), "perhaps" ("vielleicht"), and "at first glance" ("auf den ersten Blick"). Adding the verb "suspect" ("vermuten"), the qualifiers "for this reason" ("aus diesem Grunde") and "at all" ("überhaupt"), and the negative ("keinen"), gives us a sentence in which only seven out of twenty words do *not* reduce, limit, or qualify its meanings. The next sentence opens with yet another qualifier ("indessen"—"nevertheless" or "however"), then proceeds to interject at least eight layers of interference between the reader and that final, definitive verb "determine" ("fixieren"). To arrive at determination, a reader must wade through the quicksand of the passive form "it may be shown," "the concept of the probability of a state," "without yet [or still— "noch"] considering more closely," "on the basis of," "the above proposition," "just [a rough English version of "doch"] already ["schon"] in a position," "the kind of dependence" ("die Art der Abhängigkeit"), and "quite [or completely] generally."[22] In other words, entropy's dependence on probability can be demonstrated by a simple deduction. My "In other words" is itself a key qualification, for the "other words" that take a shortcut around Planck's qualifiers and convey the ostensible message of direct representation also ignore a powerful, deeper meaning in the language of the original—that these theoretical propositions are a long way from representation in language, by corollary they may never be representable, by inference linguistic representation itself becomes questionable.

In writing, of course, as in life, representation is unavoidable. Making "pictures," forming patterns and interpreting them are essential to survival and belong to the biological capacity of all species. In this context, however, we are concerned only with representation in the sense of self-representation in a text. Representation, from this point of view, can be seen as a kind of internal dialogue. That dialogue may appear to be harmonious, as when Planck describes a perfect fit between description and described, or dissonant, as in his passage above on entropy and probability. Then again it may consist in yet a third possibility—reciprocal interaction, a dynamic relationship that follows a pattern like the chiasmus, an oscillation that is particularly intricate and nuanced because the "voices" or the "moving" parts cannot be separated. Together, in their dialogue or interaction, they suggest knowledge beyond that of any fixed or single known.

Discourses other than those of scientific convention engage the conventions of science in a dialogue of mutual interrogation that produces a textual complex of dimensions exceeding the accepted boundaries of a scientific text. Planck's own prescriptions for science (for example, that it must always strive to rid itself of traces of its anthropomorphic origins) and the self-descriptions in his texts are always and again undermined by the operations of his language *despite* his adherence to the strictest scientific conventions of his time. Science implies mastery, implies hierarchies of authority claims, laws, and values. Contradiction, paradox, and subversion are meant to be excluded from its presentation. Yet by the very use of language they cannot be avoided, and in dialogue with their opposites, they tell a different story about theoretical physics. We are left with only the certainty of the linguistic self-referentiality of Planck's texts which suggests many questions about the representational nature of scientific texts.

I would like to propose that the self-undermining operations are one of the meanings imparted by Planck's texts to "scientific." Like Kuhn, I am suggesting a revisionist reading of Planck, but with the difference that I am not offering a revision of his place in the history of theoretical physics, but of readings of his texts, and by implication readings of scientific texts in general.□

[22]Following Whorf, we might have to consider here the peculiarities of the German Language. Indeed, German grammer and syntax lend themselves to this sort of construction. There may be connection between the origins of theoretical physics in the German-speaking culture, and the discourse of that science as it evolved. However, it is certain that Planck's texts are *also* made up of passages that do not operate in this manner.

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Nancy Mergler and Ronald Schleifer

COGNITION AND NARRATION:
BINARY STRUCTURES, SEMIOTICS, AND COGNITIVE SCIENCE

I

In *Semiotics and Language*, A. J. Greimas and Joseph Courtés argue that "a set of historical and pragmatic factors has given binary structures a privileged place in linguistic methodology." "This may be due," they say,

> to the successful practice of the binary coupling of phonological oppositions established by the Prague School, or due to the importance gained by binary arithmetical systems (0/1) in automatic calculus, or to the operative simplicity of binary analysis in comparison with more complex structures, since every complex structure can be formally represented in the guise of hierarchy of binary structures, etc.[1]

Greimas's semiotic square is one such hierarchy of binary structures, mapping what he calls "the elementary structure of signification." That structure, Greimas argues, is one by means of which "the human mind" constructs cultural objects "out of a desire for intelligibility."[2] Cognitive science, as it has developed its assumptions and programs for research in the twentieth century in the very different tradition of scientific empiricism, also maps cognitive behavior with models of binary structures. It does so, moreover, as Howard Gardner notes in *The Mind's New Science*, in its "empirically based effort to answer long-standing epistemological questions—particularly those concerned with the nature of knowledge, its components, its sources, its development, and its deployment."[3] In this effort, contemporary cognitive science raises questions about "mental" phenomena that

were rarely addressed in scientific and empirical psychology in the early years of the twentieth century, which was dominated by logical positivism and behaviorism.

The models of both semiotics and cognitive science are based upon the assumption that intelligibility functions by means of generalizing simplicity that is not contradicted by experience. Three elements of this formulation are essential to understanding: (1) Understanding abstracts from experience in order to discover or articulate invariables within the complexity of phenomena, invariables which can be *generalized* across a host of particular "facts" and phenomena. (2) Moreover, it does so in ways that are internally consistent (i.e., not self-contradictory) and parsimonious, attempting to achieve its understanding by the *simplest* means necessary. (3) It also does so in ways that account for as much empirical data as it can. Different approaches to understanding can emphasize one or the other of these elements: in twentieth-century linguistics, for example, Bloomfieldian structuralism emphasized the empirically *exhaustive* nature of understanding, choosing the "factual" range as its chief goal; Hjelmslev and the Copenhagen School of linguistics emphasized the logically consistent nature of understanding, choosing the *simple* systematicity of understanding as its chief goal; and Jakobson and the Prague School emphasized the *generalizing* abstract nature of understanding, choosing the articulation of the invariables of language as its chief goal.[4] In these terms, Greimas is probably closest to Hjelmslev—he called the *Prolegomena to a Theory*

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[1] A. J. Greimas and J. Courtés, *Semiotics and Language: An Analytical Dictionary*, trans. Larry Crist, Daniel Patte, et al. (Bloomington: Indiana Univ. Press, 1982) 25.

[2] A. J. Greimas, *On Meaning*, trans. Paul Perron and Frank Collins (Minneapolis: Univ. of Minnesota Press, 1987) 48.

[3] Howard Gardner, *The Mind's New Science: A History of the Cognitive Revolution* (New York: Basic Books, 1985) 6.

[4] See Ronald Schleifer, *A. J. Greimas and the Nature of Meaning* (Lincoln: Univ. of Nebraska Press, 1987) 44-67.

of Language "the most beautiful linguistic text" he had ever read—yet in his work, as in the various disciplines associated with cognitive science more generally, all three of these elements are always present to some degree.[5]

In other words, cognition itself, as a concept and an object of scientific inquiry in the twentieth century, has been understood to be the simplification and generalization of experience. In fact, Robert Rubinstein, Charles Laughlin, and John McManus—anthropologists and psychologists working in an Anglo-American empiricist tradition whose assumptions about what constitutes specific "knowledge" are very different from those of Greimas and his predecessors and colleagues in the rationalist tradition of Continental linguistics and semiotics—assert in *Science as Cognitive Process* that "perhaps the major function of the brain is to model reality."[6] That is, the nature of cognition is to simplify experience. Such modeling is a mode of simplification that can be understood in many ways: it "reduces" uncertainty; it filters out irrelevant data; it allows for the immediate (phenomenal) apprehension of Greimas's elementary structure of signification. (Here again we are repeating the elements of simplification, generalization, and exhaustive accounting in cognition.)[7]

"Cognition," Rubinstein and his colleagues say, "is a simplified representation of the operational environment"—an environment of events (26). "Although the [linguistic] message is presented for reception as an articulated succession of significations," Greimas writes, ". . . the reception can be effectuated only by transforming the succession into simultaneity"—which is to say, transforming the complexity of experience into simple understanding.[8]

For both Continental and Anglo-American researchers—even across disciplines as different as psychology, anthropology, linguistics, neuroscience, philosophy, and computer science—cognition is conceived as a way of simplifying and reducing experience to "knowledge" that, to some degree, is detachable from the experience out of which it arises, knowledge that is generalizable. In all these disciplines, moreover, the *method* of such generalization has assumed the form of the "binarity" which Greimas and Courtés describe as privileged in the twentieth century. In fact, the key models that have been used to articulate the processes of cognition in the twentieth century have taken binary form in one way or another. In his history of cognitive science, Gardner describes different models used to describe cognitive activity, all of which are based upon the assumption that cognition is a cross-cultural phenomenon. Evidence from neuropsychological syndromes resulting from war casualties in the great wars of our century, Gardner argues, produced very similar symptoms despite vastly different cultural contexts. This suggests basic, underlying processes and structures of thought—generalizable processes—that can be modeled.

The first model for the processes of cognition Gardner describes is that of "mathematics and computation." This model is based upon the logical-mathematical work of Bertrand Russell and Alfred North Whitehead that ultimately resulted in the theorem of Alan Turing which demonstrated that a simple binary machine "could in principle carry out any possible conceivable calculation" (Gardner 17). Gardner also presents the "neuronal" model, which describes the activation of neurons in terms of binary oppositions very similar to Turing's

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[5] A. J. Greimas, "Interview" in *Discussion Language*, ed. Herman Parret (The Hague: Mouton, 1974) 58.

[6] Robert Rubinstein, Charles D. Laughlin, Jr., and John McManus, *Science as Cognitive Process: Toward an Empirical Philosophy of Science* (Philadelphia: Univ. of Pennsylvania Press, 1984) 21.

[7] Simplification is usually taken to mean a mathematical reduction to common denominators. But another form of simplification could be more idiosyncratic: reduction to that which is already known, repression of irregularities. This is the difference between comfortable cognition and logical cognition, and in an important way it is a significant contribution of feminism to understanding. For instance, Julia Kristeva describes the "transcendence" of reason by the "heterogeneous element" of life which challenges "the speaker with the fact that he is not whole, but [it does] so in a manner altogether different from that in which the obsessed person's wretched consciousness ceaselessly signifies his bondage to death. For if death is the Other, life is a third party; and as this signification, asserted by the child, is disquieting, it might well unsettle the speaker's paranoid enclosure" (*Desire in Language*, trans. Thomas Gora, Alice Jardine, and Leon Roudiez [New York: Columbia Univ. Press, 1980] 271). In a way we only suggest here, the opposition between "logical" and "comfortable" cognition is the opposition (but also the relation) between cognition and narration we are examining.

[8] A. J. Greimas, *Structural Semantics*, trans. Daniele MacDowell, Ronald Schleifer, and Alan Velie (Lincoln: Univ. of Nebraska Press, 1987) 144.

model. A model for cognitive activity closely related to both of these is that of "information theory," in which, as in the models of the computer and of neurons, binarity is of utmost importance in that information theory is based on the understanding that binary oppositions (0/1) can be used to describe information "in a way entirely divorced from specific content or subject matter" (21). In cognitive science these models can be taken to be rigorously isomorphic with the functioning of human cognition: Turing's description of any conceivable calculation is a simplifying model; information theory presents a model which is generalizing in structuring "information" without recourse to the "content" of that information; and the neuronal model asserts the empirical reality of binarity in the functioning of the brain.

Thus, even in this description of cognition far removed from the terms and understanding of Greimas and the Continental semiotic tradition, cognitive science in the twentieth century— models of understanding and thought in our time—is based upon the "privileged place" of binary structures in mathematics and computation (where "every complex structure can be formally represented in the guise of hierarchy of binary structures"), in information theory (as evidenced in "the successful practice of the binary coupling of phonological oppositions established by the Prague School"), and in the "automatic calculus" of computer science (Greimas and Courtés 25). All of these binary models, as Gardner says, were "based on a shrewd hunch: that human thought would turn out to resemble in significant respects the operations of the computer, and particularly the electronic serial digital [i.e., "binary"] computer which was becoming widespread in the middle of the century" (43-44). This "hunch" is also related to what Gardner calls "the cybernetic synthesis" of "self-correcting and self-regulating systems." Such systems, in which "the human nervous system, the electronic computer, and the operation of other machines" could be understood as analogous, were named "cybernetic" systems, and they were understood to be analogous to one another—and to cognition in general—in a gesture of comprehension that is generalizing, simplifying, and accurate (20-21).

II

One example of the ways in which cognitive science has attempted to understand the functioning of understanding can be seen in recent work in cognitive psychology to devise experimental methods for measuring human understanding. In the cognitive sciences, recent discussion has focused on what F. C. Bartlett has called the "effort after meaning" and the processes of comprehension.[9] One locus for such a focus is the functioning of metaphors in language, which from classical times has been used to describe semantic cognition in terms of binary oppositions. Jonathan Culler discusses the curious status of metaphors within literary studies in recent criticism that sheds light on the study of metaphoricity as a cognitive process. Metaphor, Culler suggests, "is not simply one figure or trope among the array of tropes," but rather "the figure or figures, a figure for figurality."[10] For cognitive science, such a description calls for experimental examination— reproducible experiments that aim at accuracy and simplicity and that do not contradict a general theory of cognition.

Such experimentation takes place at the juncture between a conception of scientific knowledge that conceives of such knowledge as "objective" truths, verifiable by replicable experiment, and a second conception of knowledge that conceives of knowledge itself as interpretations rather than (or along with) "truth"—with what Barry Barnes has called the "inalienable social, collective dimension" in the constitution of knowledge, "including scientific knowledge."[11] Cognition, Barnes argues (once again in terms of binary oppositions), is the recognition of similarities—what we might call the invariants within the variants of experience. "An assertion of resemblance," Barnes writes,

. . . which is what the application of a concept amounts to in this case, involves asserting that similarities outweigh differences. But there is no scale for the weighting of similarity against difference given in the nature of external reality, or

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[9]F. C. Bartlett, *On Remembering* (Cambridge: Cambridge Univ. Press, 1932).

[10]Jonathan Culler, *The Pursuit of Signs: Semiotics, Literature, Deconstruction* (Ithaca: Cornell Univ. Press, 1981) 189.

[11]Barry Barnes, "On the Conventional Character of Knowledge and Cognition," in *Science Observed: Perspectives on the Social Study of Science*, eds. Karin Knorr-Cetina and Michael Mulkay (London: Sage Publications, 1983) 20.

inherent in the nature of the mind. An agent could as well assert insufficient resemblance and withhold application of the concept as far as reality or reason is concerned. . . . All applications of [the concept] 'dog' involve the contingent *judgment* that similarity outweighs difference in that [particular] case.

(26)

Working in the Continental tradition of semiotics, Greimas describes the perception—the re-cognition—of language in remarkably similar terms. "We perceive differences," he writes, "and thanks to that perception, the world 'takes form' in front of us and for us." Such perception, he goes on to say, is a function of both difference and similarity: "to perceive differences means to grasp the relationship between the terms, to link them together somehow" (*Structural Semantics* 19).

For both Barnes and Greimas, then, cognition "involves" the binary relationship between similarity and difference. In both, we can see the functioning of binarity in the description of understanding. This is why we can best example cognition in a discussion here of a psychological study of metaphors within the Anglo-American tradition of cognitive science. (In Continental semiotics, based as it is in philosophical and psychological phenomenology, the obviousness of the opposition between literal and figurative articulation is not so clear.) Metaphor, as Aristotle describes it in the *Poetics*, is the locus of similarity and difference: it consists, he says, in giving a thing a name that belongs to something else "by transference either from genus to species, or from species to genus, or from the species to species, or by analogy, that is, proportion."[12] As such, metaphor is the locus of intelligence, the very locus of cognition. As George Eliot says in *The Mill on the Floss,*

it is astonishing what a different result one gets by changing the metaphor! . . . It was doubtless an ingenious idea to call the camel the ship of the desert, but it would hardly lead one far in training that useful beast. O Aristotle! If you had had the advantage of being "the freshest modern" instead of the greatest ancient, would you

not have mingled your praise of metaphorical speech, as a sign of high intelligence, with a lamentation that intelligence so rarely shows itself in speech without metaphor,—that we can so seldom declare what a thing is, except by saying it is something else?[13]

Earl Mac Cormac has devoted a full-length study to the functioning of metaphor as a cognitive process. Metaphors, he argues, "can be described as a process in two senses: (1) as a cognitive process by which new concepts are expressed and suggested, and (2) as a cultural process by which language itself changes."[14] In this, Mac Cormac is arguing that metaphors are mobilized in the processes of understanding even while they are inscribed within the more or less unconscious cultural-linguistic definitions of understanding.

It is not our aim here to offer an exhaustive examination of the functioning of metaphor. Rather, we want to describe the empirical tradition of experimental psychology. In that tradition, measurement of empirical "data" is of the utmost importance: it is assumed that the index of effort one puts into cognitive activity can be measured (in carefully constrained situations) with reaction data. Thus, the time a person takes to interpret some bit of language is a window onto the effort of understanding: the transparency of the window is determined by the refinement of research manipulations. Cognitive psychologists use specific research paradigms to produce their data. While the cognitive psychologist is trained to let the data "speak for itself" by using objective tools of analysis such as inferential statistical analyses of numerical data, these psychologists must interpret the refined behavioral data just as critics interpret literary texts—or, in Barnes' model, the subject of knowledge (whether individual or collective) "applies" concepts to phenomena through a process that involve contingent judgments. In the cognitive sciences a significant unresolved issue involves the effort required to comprehend a metaphor, the effort of understanding. Most cognitive psychologists assume that a person has limited capacity or resources to process information and that we try

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[12]Aristotle, (1989) *Poetics*, trans. S. H. Butcher, in *Literary Criticism and Theory*, eds. Robert Con Davis and Laurie Finke (New York: Longman, 1989) 76.

[13]George Eliot, *The Mill on the Floss* (Boston: Houghton Mifflin, 1961) 124.

[14]Earl Mac Cormac, *A Cognitive Theory of Metaphor* (Cambridge: MIT Press, 1985) 5-6.

to conserve these resources by using them efficiently.[15] We can see in these assumptions the simplifying and generalizing aims of science in the specific injunction toward efficiency and a general "law" of the conservation of energy.

Some philosophers, such as Donald Davidson, assume that metaphor is directly and easily comprehended because all the meaning is contained within the words and their grammatical context.[16] Others, such as John Searle, argue that we interpret metaphorically only when language does not make literal (i.e., obvious) sense.[17] In this, he suggests, the nature of metaphor is *situated*: for instance, the sentence "some birds are carrots" is nonsense in the abstract and in most situations, but it is a meaningful figure in the context of orange birds.[18] At the furthest extreme, a philosopher like Nietzsche argues that all meaning is figurative, that it is, as he says, the imputation of significance—which is to say, the "inscription" of cognitive structures—upon more or less undifferentiated experience. Barnes in his discussion of concept application comes close to this position.

Cognitive psychology attempts to measure empirically the functioning of metaphorical comprehension, even though quite often the very experimental design of such measurements silently entail assumptions about the nature of the activity they measure. Samuel Glucksberg, for instance, uses a sentence verification paradigm to test whether people can ignore the metaphorical meaning of statements when they are asked to quickly judge literal truth or falseness of many sentences—some of which are powerfully metaphorical.[19] In this, Glucksberg assumes that cognition is simply a matter of recognizing matters of fact (true or false). In discussing his experiment, he argues that when a metaphor such as "Some jobs are jails" is encountered during this true/false reaction-time task, subjects want to respond "false," but hesitate because they cannot ignore available metaphoric interpretations. Glucksberg's data seem to support his thesis. In his experiments, reaction time to deny the literal truth value of metaphors is slower than reaction time to deny what psychologists call "standard" false assertions (e.g., "some birds are carrots")—assertions which, in the abstract, are "obviously" false.[20] Glucksberg calls this discrepancy between the speed with which a subject judges an obviously false abstraction "false" and the speed with which the same subject judges an abstraction which can be figuratively true "false" a metaphor interference effect. These data can be interpreted to mean that literal and metaphorical meaning are accessed—that is, cognitively processed—simultaneously. In this interpretation, the recognition of metaphorical meaning does not merely follow *after* a failed attempt to interpret a sentence literally as Searle has suggested. Rather, only when subjects are enjoined to measure metaphorical abstractions against abstract standards of "objective" literal truth (in terms of the binary opposition true/false) does the time of cognitive processing take longer. This suggests that the binary opposition between the "objectively" literal and the "non-objective" figurative presents problems: the *meaning* of figures is processed—recognized—as quickly as so-called "objective," literal meaning.

Another cognitive psychologist, Andrew Ortony, has studied the asymmetry of metaphors, the fact of their irreversibility.[21] While "A friend is an anchor" seems an

[15]See W. Hirst and D. Kalmar, "Characterizing Attentional Resources," *Journal of Experimental Psychology* 116 (1987): 68-81; and D. Navon and D. Goopher, "On the Economy of the Human Processing System," *Psychological Review* 86 (1979): 214-55.

[16]See Donald Davidson, "What Metaphors Mean," *Critical Inquiry* 5 (1978): 31-47.

[17]See John Searle, "Metaphor," in *Metaphor and Thought*, ed. Andrew Ortony (New York: Cambridge Publishers, 1979) 94-123.

[18]See Walker Percy, *The Message in the Bottle* (New York: Farrar, Straus and Giroux, 1979) 64-82.

[19]S. Glucksberg, P. Gildea, and H. B. Bookin, "On Understanding Nonliteral Speech: Can People Ignore Metaphors?" *Journal of Verbal Learning and Verbal Behavior* 21 (1982): 85-98; see also P. Gildea and S. Glucksberg, "On Understanding Metaphor: The Role of Context," *Journal of Verbal Learning and Verbal Behavior* 22 (1983): 577-90.

[20]What makes such propositions "obvious" in their truth value is the manner in which the sentence is detached from all social and interpersonal contexts. For a discussion of such abstraction, see N. Volosinov [M. M. Bakhtin], *Marxism and the Philosophy of Language*, trans. Ladislav Matejka and I. R. Titunik (Cambridge: Harvard Univ. Press, 1986) 99-106.

[21]Andrew Ortony, "Beyond Literal Similarity," *Psychological Review* 86 (1979): 214-55.

acceptable metaphor to subjects in an experimental situation, "An anchor is a friend" seems odd to those same subjects. Here, in the cognition of metaphorical meaning, the relationship between similarity and difference—which functions in all cognition—appears as a special case. Metaphors contrast a low salient attribute of the grammatical subject with the same but now high salient attribute of the predicate. In this example, for instance, stability is a valid attribute but not a highly salient attribute of the concept "friend," while stability is a defining, highly salient attribute of "anchor." In his work, Ortony had people rate the quality of metaphors in both the standard and reversed orders of subjects and predicates. His experimental subjects clearly preferred the standard order of presentation in their ratings, but he did not record response speed to assess the difficulty of interpreting reversed metaphor.

The difficulty of separating a metaphor's effectiveness from a metaphor's interpretability is at issue. This is the difficulty of separating the articulation (or generation) of meaning from the communication of meaning, an issue of the utmost importance to Greimas and Continental semiotics, but, as we have seen, it is of great importance to Mac Cormac as well.[22] The question left unanswered by Ortony—and by the very "empirical" assumptions embedded in the use of time measurements to study the cognitive functioning of metaphors—is this: are the best metaphors, understood in the cognitive functioning of the articulation of meaning, easily interpreted or are they interpreted at considerable effort? Is the effort of interpretation, whether easy or time consuming, related to cognitive articulation? Moreover, if the "best" metaphors involve more effortful cognitive processing (in either articulation or interpretation), does this "effort" involve more information—situated rather than abstract "objective" propositions, what linguists call "marked" rather than "unmarked" forms? And, finally, can "meaning" be distinguished from "truth" precisely by means of this cognitive effort?

In a series of experiments to assess these questions, Monica Gregory and Nancy Mergler used response time as an index of cognitive effort.[23] A few changes in the Glucksberg paradigm allowed for this. Glucksberg had placed his subjects in a *literal truth response set*: their responses were to a sentence's literal truth or falsity. (This is a fairly standard experimental manipulation, but it is a strange way of dealing with language in that it skirts the issue of meaningfulness.) Gregory and Mergler, however, added a *metaphoric response set* to the Glucksberg paradigm so that subjects were asked to respond "yes" to sentences that seemed to present "meaningful metaphors" and "no" to sentences that seemed to present no metaphorical meaning. In these situations, subjects could follow the instructions and respond "no" to literally true sentences when no metaphorical meaning was apparent. Moreover, the error rates were the same as those in the literal truth response set. In these experiments, as in Glucksberg, subjects responded faster in judging ("true" or "false") literal truth than in judging metaphorical meaningfulness, which suggests that this second judgment is harder and more effortful. This is quite important because it suggests that subjects can separate "truth" and "meaning."

In these two experiments the same sentences were presented to subjects, and they were able to judge these same sentences "false" in the first set (Glucksberg metaphor interference effect) and "meaningful metaphors" in the second, and also "true" and "non-metaphorical." This is striking because in the second instructional set there could be no "errors" as such: as Barnes suggests, a judgment of metaphoricity can always be made. Still, the sentences most frequently judged metaphorical were standard metaphors and reversed metaphors (Aristotle's species/genus relationships). Less likely to be judged metaphorical by these subjects were scrambled metaphors and "standard" false propositions. But any utterance can yield metaphorical interpretation—as Barnes says, in a *particular* situation "there is no scale for the weighting of similarity against difference given in the nature of external reality, or inherent in the nature of mind"—even though it takes great effort (more time) to interpret standard false sentences as good, meaningful metaphors (26). That is, in these cases more information needs to

[22]See Herman Parret, *Semiotics and Pragmatics* (Amsterdam: John Benjamins, 1983); Schleifer, *A. J. Greimas* ch. 5; and Ronald Schleifer, "Deconstruction and Linguistic Analysis," *College English* 49 (1987): 381-95.

[23]Monica Gregory and Nancy Mergler, "Metaphor Comprehension: In Search of Literal Truth, Possible Sense, and Metaphoricity," *Metaphor and Symbolic Activity* 5 (1990: 151-73.

be processed.

The data from these experiments suggest that the easiest task for subjects was to say "true" to literal truth, then to say "no" to the possibility of metaphoricity (to judge the sentence nonsensical). Saying "no" to the metaphorical possibility of literal truth was third fastest. Here, the potential interpretation of meaning in a sentence that is not true slowed down cognition. This is what Walker Percy calls the phenomenon of "mistakes—misnamings, misunderstandings, or misremembering [—resulting] in an authentic poetic experience," a cognitive experience of meaning (65). But even though it took more time, this too was a judgment of the nonsense of the sentence. Finally, the slowest and most ambiguous response was to say "yes" to metaphoric meaningfulness.

Gregory and Mergler argue that language decisions for ordinary language comprehension entail these three stages of judgment—three binary cognitive activities—because such staging conserves "effort after meaning" in the long run. First, they argue, linguistic cognition scans for literal, obvious *truth* (as opposed to untruth); then it rejects information as *nonsense* (as opposed to meaning); then it seeks "hidden," metaphorical meaning, precisely because the effort it requires entails the *marking* of information with the addition of more information. Such marking is the contextualizing and re-contextualizing of meaning—the very *situating* of meaning in relation to the "objective" truths of the world. These stages in the process of the cognitive apprehension of metaphors can be drawn on Greimas's semiotic square.

truth < · · · · · · > falseness

meaning < · · · · · · > nonsense

(marking/situating)   (unmarked)
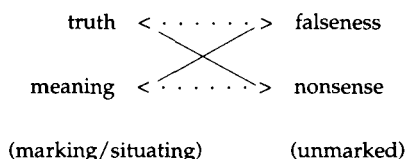
This schema maps the cognitive activity of semantic processing in the double binary oppositions of Greimas's square (the "contrary" opposition of truth and falseness and the "contraditory" opposition of truth and nonsense). In this, it describes the absence of truth not as simply "falseness" but also as undifferentiated, unmarked "nonsense." This suggests that meaning and truth are not identical—their identity is an assumption in Glucksberg's original experimental design—and

it suggests that the mark of their difference is the *process* of marking and situating of meaning— the *emergence* of meaning that, in fact, can be narrated.

In other words, the methodological articulation of cognition within an experimental, empirical framework of assumptions takes place in terms of the *narrated stages* of simple and complex binary oppositions. The attempt to trace the functioning of cognition by observing and measuring its operations as accurately as possible produces what Greimas calls a little narrative drama (see *Structural Semantics* 198-99) —"truth" in conflict with "falseness," confronting undifferentiated "nonsense" and finally saved from these dizzying complications through the agency of "meaning." The crucial question that arises from the superimposition of Greimassian semiotic frameworks upon empirical, experimental "data" is: which framework is primary? Does the logic of Greimassian understanding determine our "perception" of data (in this case conceived as "phenomena"), or does the nature of accurately measured data determine what is perceived (what constitutes phenomena)?

III

It is impossible to decide between these alternatives, but, at the same time, it is possible to shift the framework of understanding and take this very impossibility of choosing between logic and data in grounding understanding as something to be examined. One such shift could attempt to *situate* cognitive activity—to ask what particular functions it accomplishes in particular situations and what elements of unconscious power inhabits its conscious knowing as an activity that is instituted within culture. In this examination, the privileged place of binary structural accounts of cognition would be seen, as Greimas and Courtés argue, to be pragmatic and accidental, but the very "accident" of binarity would be seen in a historically determined context. Binary structures—those of one-to-one opposition—are a function of the perception of the breakdown of hegemonic self-evident truths. When truths are self-evident, there is no need to self-consciously define the true against its opposite. (There is also no need to distinguish between truth and meaning or epistemology and method.) As Jacques Derrida has attempted to show repeatedly, binary oppositions are "never the face-to-face

opposition of two terms, but a hierarchy and an order of subordination."[24] Paul de Man also notes, "binaries, to the extent that they allow and invite synthesis, are therefore the most misleading of differential structures."[25] Binaries, in other words, are most misleading because they present, in all their "oppositions," a sense of truth and counter-truth at play while, at the same time, they covertly reestablish hierarchical power, the sense that one of the elements of its binary opposition can always be seen to embody the general term that encompasses the *whole* of the opposition (see Schleifer, "Deconstruction" 387-92). In this way, the very historical and pragmatic *emergence* of binary structures as a privileged methodology in linguistics and cognitive science takes its place in the *historical* breakdown of hierarchic orderings of experience and perception in the early modernist period: binarity itself responds to the felt need to reestablish hierarchical order in the face of what T. S. Eliot describes as this "futility and anarchy" of the early twentieth century.[26]

A second way to address the problem of articulating a framework for understanding cognition in the face of the impossibility of reconciling the divergent assumptions of cognitive science and semiotics is to emphasize rather than ignore the distinction between truth and method. If "frameworks" of understanding—whether they focus on "empirical" data (as cognitive science does) or phenomenal "experience" (as semiotics does)—are simply methodological ways of ordering understanding, then the question of the *nature* of knowledge, of its components, of its sources, of its development, of its deployment, seems irrelevant. Both semiotics and cognitive science have pursued this attempt to maintain the binary opposition between method and content. Semiotics, however, has been more self-conscious

in this. For this reason, in their definition of binarity, Greimas and Courtés are careful to emphasize the methodological rather than an epistemological understanding of binary oppositions. The example they use to distinguish methodological binarity from epistemological "binarism" is Roman Jakobson, for whom, they say, "the binary articulation or grasp of phenomena is one of the characteristics of the human mind" (Greimas and Courtés 25). Unlike most other twentieth-century semioticians, Jakobson consistently argued for the isomorphic functioning of binarism across *all* levels of the functioning of language, from the "distinctive features" which, in "bundles" of binary oppositions, comprise the phonemes of language, to the binary oppositions that govern the semantics of poetry and discourse in general. For this reason, Lévi-Strauss was able to develop the narratology of structuralism based upon Jakobson's binarism, and Greimas was able to develop his elementary structure of signification by working out Lévi-Strauss's critique of Propp in "Structure and Form" in the analysis of Propp in *Structural Semantics*. (As Greimas later noted, Propp's *Morphology of the Folktale* is a special case of a more general semio-narrative understanding of discourse.)

The power of such formal structures, not only in Jakobson and Greimas but in the understanding of cognition itself, is the rhetorical power of the spatial figures that create the meaning-effects of "knowledge"—the self-evident "recognitions" of cognition—by conceiving of phenomena as "substantial." It makes the objects of cognition, as Bruno Latour says, both permanent and transportable from context to context.[27] Greimas narrates this process of producing meaning by describing the tendency of discourse to "substantify" relationships so that "whenever one opens one's mouth to speak of relationships, they transform themselves, as if by magic, into substantives."[28] Greimas is describing the nature of language which, as he sees it, creates the effect of cognition by giving rise to phenomenally "substantial" referents for its designations: when

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[24]Jacques Derrida, *Margins of Philosophy*, trans. Alan Bass (Chicago: Univ. of Chicago Press, 1982) 329.

[25]Paul de Man, *The Resistance to Theory* (Minneapolis: Univ. of Minnesota Press, 1986) 109.

[26]T. S. Eliot, *Selected Prose*, ed. Frank Kermode (New York: Harcourt Brace, 1975) 177. For an account of intellectual, perceptual, and cultural responses to the crisis of modernism (which includes "binarity" as one such response), see Ronald Schleifer, *Rhetoric and Death: The Language of Modernism and Postmodern Discourse Theory* (Urbana: Univ. of Illinois Press, 1990) ch. 2, ch. 5.

[27]Bruno Latour, "Visualization and Cognition: Thinking with Eyes and Hands," in *Knowledge and Society: Studies in the Sociology of Culture Past and Present* 6 (1986): 1-40.

[28]A. J. Greimas, *Du Sens* (Paris: Seuil, 1970) 8; our translation. See also Schleifer, *A. J. Greimas* 40-43.

meaning is apprehended, even when it articulates a relationship, the act of designating that relationship causes it to seem to be not simply a method of "producing" meaning but a simple act of perceiving preexisting "data." For instance, Saussure's word *signifier* (the French *signifier*, literally the "signifying") transforms relationship into a spatially locatable substance. Or, in another instance, methodology—such as the methodology of binarity Greimas and Courtés describe—transforms itself, as if by magic, into epistemology.

The power of substantification (Latour's "inscription") responds, unconsciously, to the overwhelming uncertainty of early twentieth-century Europe with the rhetorical effect of "objective" scientific phenomena which can be cognitively manipulated and configured. This is why, as Mikhail Bakhtin says, that in the twentieth century "the *declaratory* word remains alive only in scientific writing" (159). In such writing the existence of things remains "alive" precisely because, in the purely instrumental conception of "method, " cognitive "truth," like Eliot's "tradition," transcends the temporalities of narrative discourse. This is the reason that Anglo-American cognitive science makes so much of hierarchical levels: they subordinate truth to method just as Greimas subordinates the temporal emergence of meaning in language to "immediate," phenomenal cognitive apprehension. Greimas even goes so far as to assume the binary oppositions of the rationalism of Chomskyan linguistics—"deep level" vs. "surface level" (Greimas and Courtés 134); "competence" vs. "performance"; the "generative" nature of semiotics—even though Chomskyan rationalism (Cartesian rationalism that substantifies "mind") is far from the tradition of Continental semiotics within which Greimas and his colleagues work.[29]

IV

In fact, Greimas is an instructive example of the relationship between cognition and narrative precisely because he brings many of the assumptions of cognitive science to the study of narrative structures themselves. Beginning in *Structural Semantics* Greimas explicitly analyzes discourse in terms of its articulated or "substantified" *agents*—what he calls the "actants" of narrative—rather than its represented *activities*—what he calls (following Propp) the "functions" of narrative. By focusing on the aspects of language that call for a rhetoric of space and inscription, Greimas demonstrates a greater possibility of analysis and, of course, of cognitive configuration (*Structural Semantics* xxxviii). Put extremely, without some kind of cognitive "mediating structures," conceived more or less consciously in spatial metaphors, the "social system" of language, as Greimas and Courtés note in *Semiotics and Language* under the heading "Enunciation," can only be "scattered into a infinite number of examples of speech (Saussure's *parole*), outside all scientific cognizance" (103). It is precisely such scattering that was the felt experience of European modernism.

In the same way, Derek Attridge situates Jakobson's poetics within an opposition between conceiving of poetry as functioning "to heighten attention to the meanings of words and sentences" and conceiving of poetry as "a linguistic practice that specially emphasizes the material properties of language . . . independently of cognitive content."[30] This opposition, which Attridge suggests functions unconsciously in Jakobson, opposes a "formal" and "cognitive" understanding of meaning to a "material" and "phenomenal" understanding. Doing so, it suggests that even the seemingly "phenomenal" effects of language can be accounted for within the structures of binary opposition and that, in Derrida's paraphrase of Husserl, "meaning is everywhere."[31] That is, doing so, it reiterates, in the face of its denegation, a chief tenet of the ideology of liberal bourgeois society of the turn of the twentieth century, in which the real is rational (Schleifer, *Rhetoric and Death* ch. 2).

The same opposition can be seen in Anglo-American cognitive psychology more generally. In the last three decades, in response to the hegemony of behaviorism in psychology, cognitive psychology, as we have seen, has reintegrated cognition and meaning into the science of psychology in the same way that Jakobson's project and that of Prague Linguistics

[29]A. J. Greimas, "On Meaning," trans. Paul Perron and Frank Collins, *New Literary History* 2 (1989): 540.

[30]Derek Attridge, *Peculiar Language* (Ithaca: Cornell Univ. Press, 1988) 130.

[31]Jacques Derrida, *Positions*, trans. Alan Bass (Chicago: Univ. of Chicago Press, 1981) 30.

has been to describe the basic linguistic function at all levels as "the distinction of meanings."[32] Bartlett argued early in the debate that memory was constructive and could be explained as "effort after meaning"; Jean Piaget suggested that all life is involved in genetic epistemology which actively constructed systems for acquiring knowledge; Uric Neisser situated the subject in a social and human context to examine how we get by, how we use these systems to construct a workable reality.[33] A chief proponent of this reconfiguration of scientific psychology is Jerome Bruner, who, in a career that has repeatedly attempted to define meaning and understanding, has created the groundwork for studies such as that of the functioning of metaphoric cognition we examined earlier within his discipline. In *Actual Minds, Possible Worlds*, Bruner presents the same kind of opposition between cognitive and non-cognitive conceptions of understanding as we find in Jakobson and Greimas. But here, unlike the study of metaphoric functioning we examined earlier, he does so explicitly in relation to an opposition between apprehension and narrative, what he calls "two natural kinds" of understanding.

These "two modes of thought," these "distinctive ways of ordering experience, of constructing reality," are "a good story and a well-formed argument," what Bruner calls "the narrative mode" and "the paradigmatic or logico-scientific" mode.[34] The second of these "yields accounts of experience that are replicable, interpersonally amenable to calibration and easy correction" (110); while the first "leads to conclusions not about certainties in an aboriginal world, but about the varying perspectives that can be constructed to make experience comprehensible" (37). In this, Bruner is pursuing the old controversy between the arts and sciences, the "two cultures," and at its best

his argument is able to bring these "fundamentally different" modes of verification (11) together in a coherent argument that convinces us both of its "truth" and its "lifelikeness" (versions of the "truth" and "meaningfulness" of the Gregory/Mergler study). Of Jakobson's contention that the nature of "literariness" is to make "the world strange again, " Bruner argues that "this ingenious intuition can be given a psychological rendering [open to] . . . empirical research" (75). Throughout *Actual Minds, Possible Worlds*, Bruner offers empirical studies to substantiate narrated theories. He uses the linguistics-based theories of Tzvetan Todorov—theories governed by the structuration of binary oppositions—to distinguish between narrative and expositional discourse, and then discusses an experiment in which subjects re-narrated Joyce's "Clay" to describe the narrative mode of thinking. In another instance, he returns to one of his own early experiments which examined how subjects construct abstract "realities" or "wholes" from amorphous experience to discover, on retesting, what he had overlooked in the 1950s, namely that subjects can use either of the two modes of cognitive processing to produce "world constructions" (89-92).

Most interesting to us here is the fact that Bruner, like Jakobson and de Man, shapes his understanding by means of binary oppositions —the means of the paradigmatic or logico-scientific mode of understanding—even while he does so in the context of a narrative account of his career and the career of cognitive psychology more generally. Thus in the most impressive chapter of the book he narrates "how the three modern titans of developmental theory—Freud, Piaget, and Vygotsky—may be constituting the realities of growth in our culture rather than just describing them" (136) in order to narrate the *situation* of cognitive psychology in a world subject to nuclear destruction, a world that needs to construct the narrative of its future (149). That is, here, as in Jakobson and de Man, there is a constant pressure of binary oppositions to mark themselves as positive and negative and, as we mentioned earlier, covertly reestablish hierarchical power. To do so, they articulate the cognitive understanding of binarity—even when, as in moments in Bruner, the "good story" of "the narrative mode" seems to take precedence.

Fredric Jameson emphasizes a similar opposition in Greimassian semiotics when he

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[32]Roman Jakobson, "The Concept of the Sound Law and the Teleological Criterion," in *Selected Writings: Volume 1, Phological Studies* ('S-Gravenhage: Mouton, 1962) 1.

[33]Jean Piaget, *Structuralism*, trans. Chaninah Maschler (New York: Basic Books, 1970) 52-73; Uric Neisser, ed., *Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorization* (Cambridge: Cambridge Univ. Press, 1987).

[34]Jerome Bruner, *Actual Minds, Possible Worlds* (Cambridge: Harvard Univ. Press, 1986) 11, 12.

describes the dialectic between the "profound narrativity of all thinking" in Greimas's work—an aspect of his work which focuses on the *production* of meaning—and the "specialized abstract" cognitive mode of thinking that equally governs his understanding of meaning.[35] This dialectic is clear in the recent work which explores modal understandings of meaning, which, as Jameson notes, assumes that mental processes are cognitive (ix). At crucial moments, even studies most fully governed by the methodology of binarity transcode the level of analysis to that of narrative. In Greimas's "lexical semantic" study of anger, for instance, after a detailed semantic analysis that repeatedly produces more and more minute binary discriminations (see the explosion of binary oppositions in a single paragraph of the analysis [150]), the analysis suddenly shifts to terms of narrative analysis.[36] Moreover, in a short section of this study Greimas narrates the very act of cognition by describing three different levels whose order of presentation offers a narrative progression that recapitulates the narrative trajectory of his semiotics. In this, his analysis is close to the narration of three levels of metaphoric cognition in the Gregory/Mergler experiments. First he presents an "empirical" or "accidental" reading of anger in an analysis based upon the narrative functions (abstract invariable narrative "events") developed by Vladimir Propp (the simple presence of the function "lack and its liquidation" [161]). Then he focuses on the meaningfulness of this narrative by investing Propp's function of "glorifying test" with a new semantic meaning. He does this by renaming the function of "recognition" the "cognitive sanction" of language, the reinstitution in the narrative of "the language of truth" (162). Finally, examining the terminal functions of the narrative progression of anger (the first and last Proppian functions that occur in the *activity* of anger), he opposes the "cognitive sanction" at the end of an episode of anger to an initial "fiduciary lack" at the beginning (162). In this, he reinscribes binary oppositions—that between nonsense and meaning—within the narrative discourse of his

short analysis by replacing "causal description" with the "semantic description" of narrative (164).

In this discussion Greimas uses hierarchical binary structures—the very structures of Continental structuralism—which are quite similar to structures that inhabit Anglo-American cognitive science. Moreover, it is an example of the way such binary structures encompass the dialectic of modernism that both articulates and resists the futility and anarchy of its historical moment. As in Bruner, the binary oppositions of Greimas's "actantial" analysis do not preclude "functional" analysis but rather attempt to create a metalanguage that allows for the complex analysis of meaning, which is always both cognitive and narrative, always both an achieved order and a struggle for order. Such complexity can be seen in modernist formalism from Eliot's attempt to recuperate a "deep" and "transcendental" meaning from the flux of Joyce's and his own experience to the hypostasizations of the formal opposition of stimulus and response within the chaos of mindless behavior in behaviorism, which also attempts the recuperation of transcendental value in the face of what Stevens calls "a great disorder." Continental structuralism, however, as Lévi-Strauss has argued, aims at *situating* such formalism. This is unlike Russian or New Critical formalisms or the behavioral formalisms of Bloomfield in linguistics and in the behavioral psychology of the 1930s more generally, all of whose forms are abstract paradigms completely separate from the actual, temporally situated phenomena they study. In all these disciplines, method and truth are readily separated. Lévi-Strauss argues, however, that structuralism arrests and apprehends the "logical organization" of phenomena "conceived as a property of the real."[37] That is, the structures of structuralism—including the methodological binarities of Greimassian semiotics and Brunerian cognitive science—do not simply assert the existence of nonmaterial abstract entities such as Glucksberg's opposition between truth and falseness, but rather they attempt to recuperate, modally and functionally,

[35]See Fredric Jameson, foreword, *On Meaning*, by A. J. Greimas, trans. Paul Perron and Frank Collins (Minneapolis: Univ. of Minnesota Press, 1987) vi-xxii.

[36]See A. J. Greimas, "On Anger: A Lexical Semantic Study," in *On Meaning* 148-64.

[37]Claude Lévi-Strauss, "Structure and Form: Reflections on a Work by Vladimir Propp," trans. Monique Layton, rev. Anatoly Liberman, in Vladimir Propp, *Theory and History of Folklore* (Minneapolis: Univ. of Minnesota Press, 1984) 167. See F. W. Galan, *Historic Structures: The Prague School Project, 1928-1946* (Austin: Univ. of Texas Press, 1985) 35, for Mukarovsky's earlier criticism of formalism in similar terms.

the phenomenological and temporal processes of apprehension and organization. Like the opposition of presence and absence in the distinctive features of phonemes, they allow the phenomena studied to exist as phenomena both in time and in cognitive apprehension. In this, they allow for logical structures and a plurality of cultures by allowing narrative temporality a functional place within cognitive activity. The relationship between cognition and narration is, as Greimas says of narrative in general, "neither pure contiguity nor a logical implication" (*Structural Semantics* 244). For this reason, phenomenal meaning-effects exist and function as narrative units *because* logical organizations are apprehended as real temporal events—cultural events. Here the binary opposition between narrative and cognition, method and epistemology, story and argument, breaks down precisely because this binary opposition itself is both true and false—which is to say, both true and meaningful, perception and heurism—at the same time.

In other words, the felt sense of opposition within any articulation of meaning—the method (which is also more than a method) of binarity —is central to semiotics and cognitive science in the same way it is central to the modernism and postmodernism we inhabit. This opposition exists, as does Greimassian semiotics and

Brunerian cognitive psychology, because at this historical moment the sureties of order and the self-evidence of value are in question.The work of semiotics and cognitive science—the work of psychology itself in its broadest definition, which encompasses the perception of truth, the generation of meaning, and the problematics of subjectivity—articulates this situation, *enunciates* it (even in its "scientific" language and often magisterial pronouncements), in its constant oscillation between transcendental cognition and situated narrative, an opposition which it schematizes and substantifies and which, nevertheless, it also always narrates and situates within the processes of analysis and understanding.☐

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N. Katherine Hayles

CONSTRAINED CONSTRUCTIVISM: LOCATING SCIENTIFIC INQUIRY IN THE THEATER OF REPRESENTATION

I. The Theater of Representation

One of the important developments in science studies has been the increased awareness that scientific inquiries are social and ideological constructions. Donna Haraway's explorations of primatology, Shapin and Schaffer's investigations into the sociology of Boyle's laboratory, and Bruno Latour's study of "black boxes" in science are only a few of the seminal analyses that have challenged accounts of how science is done.[1] So extensive and successful have these critiques been that it now seems the aspect of science most in need of explanation is its power to arrive at apparently ahistorical and transcultural generalizations. Given that science is socially constructed, how can we explain, as Michel Serres puts it, that "entropy increases in a closed system, regardless of the latitude and whatever the ruling class."[2]

A clue can be found in a curious lacuna that occurs when this question is discussed within the philosophy of science. There the debate has been constructed as a division between the realists and the anti-realists. Both sides grant that there is something called observables, and that these observables have an instrumental efficacy in the world. You tighten a loose battery cable, and the car starts where it would not before. The difference comes in whether or not the observables relate to entities that exist in reality as such. The realists say there really is an electrical current that flows, while the anti-

realists want to weaken or deny this claim. The lacuna occurs in the anthropomorphic grounding that underlies the idea of observables. Without being explicit about it, both sides mean observable from a human perspective. This assumption has important implications.

Consider a frog's visual cortex. Studies indicate that objects at rest elicit little or no neural response in a frog's brain.[3] Maximum response is elicited by small objects in rapid, erratic motion—say, a fly buzzing by. Large objects evoke a qualitatively different response than small ones. This arrangement makes sense from a frog's perspective, because it allows the frog to identity prey from non-prey, and prey from predators that want to eat it. Now imagine that a frog is presented with Newton's laws of motion. The first law, you recall, says that an object at rest remains so unless acted upon by a force. Encoded into the formulation is the assumption that the object stays the same; the new element is the force. This presupposition, so obvious from a human point of view, would be almost unthinkable from a frog's perspective, since for the frog moving objects are processed in an entirely different way than stationary ones. Newton's first law further states, as a corollary, that an object moving in a straight line continues to move so unless compelled to change by forces acting upon it. The proposition would certainly not follow as a corollary for the frog, for variation of motion rather than continuation counts in his perceptual scheme. Moreover, it ignores the *size* of the object, which from a frog's point of view is crucial to how information about movement is processed.

My point is not that humans know what frogs

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[1]Donna Haraway, "Animal Sociology and a Natural Economy of the Body Politic, I and II," *Signs* 4 (1978): 21-60; Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton Univ. Press, 1985); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open Univ. Press, 1987).

[2]Michel Serres, *Hermes: Literature, Science, Philosophy,* eds. Josué V. Harari and David F. Bell (Baltimore: Johns Hopkins Univ. Press, 1982) 106.

[3]J. Y. Lettvin et al., "What the Frog's Eye Tells the Frog's Brain," *Proceedings of the Institute for Radio Engineers* 47 (1959): 1940-51.

cannot fathom. The scientists who did the frog research put it well: their work "shows that the [frog's] eye speaks to the brain in a language already highly organized and interpreted instead of transmitting some more or less accurate copy of the distribution of light upon the receptors" (Lettvin 1950). This and other studies conclusively demonstrate that there can be no perception without a perceiver.[4] Our so-called observables are permeated at every level by assumptions located specifically in how humans process information from their environments.

Observing with instruments rather than unaided human perception does not rescue us from our anthropomorphism, for the instruments we design and build are just those that would be conceptualized by someone with our sensory equipment. Instruments extend and refine human perceptions, but they do not escape the assumptions encoded within the human sensorium. Add the profound influence of acculturation upon cognitive processing, and it becomes clear that observables really mean observations made by humans located at specific times and places and living in specific cultures. In short, we are always already within the theater of representation. Everything we perceive, think, or do is always already a representation, not reality as such.

Yet representation may be too passive a concept to account for the complexities involved. Research by Walter Freeman and Christine Skarda on the olfactory bulb of rabbits indicates that perceptual processing is context-dependent as well as species-specific.[5] Rabbits continually sniff; these sniffs take in molecules of odorants that fall on the cilia of receptor cells in the nose, which in turn are connected to mitral cells in the olfactory bulb of the cortex. When the odors are neutral, oscillatory bursts of neural activity appear that can be reliably identified as characteristic of a given animal.

When the animal sniffs an odor that he has been conditioned to recognize as significant, a different pattern appears. Then the burst is amplified in a cascading effect that brings together selectively co-activated neurons in a nerve cell assembly. This amplification happens very fast, within milliseconds. At certain critical thresholds, further changes take place that affect the entire global area of the olfactory bulb. The data demonstrate that perception is not a passive response to stimuli but an active process of self-organization that depends on prior learning and specific contexts. "Perception begins *within* the organism with internally generated neural activity," Skarda writes ("Understanding Perception" 52). "What happens within the brain is about interaction" (53).

Although the data vary with individual animals and between species, additional experiments on the visual cortex of the monkey and the somatosensory cortex of a human subject indicate that the active, self-organizing nature of perception applies in these cases as well.[6] On this basis, Skarda and Freeman have argued that neuroscience should give up the concept of representation (which Skarda calls "representationalism"), because it encourages the fallacy that perception passively mirrors the external world. Representation in this sense happens only when an observer enters the scene. It is the *experimenter's* viewpoint, Skarda writes, which "requires that conclusions be drawn about what the observed activity patterns represent to the subject" ("Understanding Perception" 57). From this vantage, our anthropomorphism has not only led us to universalize our species-specific perspective into a vision of an autonomously existing reality but also to falsify the nature of our own perceptual processing.

The point is telling. I am not willing, however, to relinquish a term as central to literary discourse as representation. I want to introduce another way of formulating it that will make representation a dynamic process rather than a static mirroring. Suppose we think about the reality "out there" as an unmediated flux. The term emphasizes that it does not exist in any of the usual conceptual terms we might construct (such as reality, the universe, the world, etc.) until it is processed by an observer. It interacts with and comes into consciousness through self-

[4]For a summary of visual mechanisms in different species, see *Models of the Visual Cortex*, eds. David Rose and Vernon G. Dobson (New York: John Wiley and Sons, 1985).

[5]Christine A. Skarda, "Understanding Perception: Self-Organizing Neural Dynamics," *La Nuova Critica* 9-10 (1989): 49-60. See also Walter Freeman and Christine Skarda, "Mind/Body Science: Neuroscience on Philosophy of Mind," *John Searle and His Critics*, eds. E. LePore and R. van Gulick (London: Blackwell, 1988); and "Representations: Who Needs Them?" *Proceedings 3rd Conference on the Neurobiology of Learning and Memory* (forthcoming).

[6]Walter Freeman, private communication.

organizing, transformative processes that include sensory and cognitive components. These processes I will call the cusp.

On one side of the cusp is the flux, inherently unknowable and unreachable by any sentient being. On the other side are the constructed concepts that for us comprise the world. Thinking only about the outside of the cusp leads to the impression that we can access reality directly and formulate its workings through abstract laws that are universally true. Thinking only about the inside leads to solipsism and radical subjectivism. The hardest thing in the world is to ride the cusp, to keep in the foreground of consciousness both the active transformations through which we experience the world and the flux that interacts with and helps to shape those transformations. For as soon as the thought forms, we become aware of the paradox: what we imagine is not the cusp itself, but the representation of it that is in our conceptual realm.

The reflexive mirroring that enfolds cusp into concept shows how we can be trapped within the prison house of language. This inherent reflexivity was part of what Derrida had in mind when he famously proclaimed, "There is no outside to the text."[7] As long as positive assertions are made, there is indeed no way out of the reflexive loop, no way to conceptualize the cusp without always already falling short of what the conceptualization attempts to represent. Negation, however, is a more complex and ambiguous function. In negation, possibilities for articulation exist that can elude the reflexive mirroring that would encapsulate us within textuality and nothing but textuality. This elusive negativity authorizes a position that grants the full weight of the constructivist argument but draws back from saying anything goes. Such a position is necessary if science is to retain its distinctive characteristic as an inquiry into the nature of the physical world, while also rightfully being recognized as an arena of social discourse and cultural practice. Central to it are contexts, consistency, and constraints. Their interaction allows the cusp to be posited and its relation to elusive negativity explored.

II. Riding the Cusp:
What We Remember, What We Forget

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[7]Jacques Derrida, *Dissemination*, trans. Barbara Johnson (Chicago: Chicago Univ. Press, 1981).

This afternoon Hunter and I went for a walk. Hunter is a handsome, medium-sized dog, half beagle and half hound. Hunting rabbits is bred into his genes, and there are a lot of rabbits where we live. It is not uncommon for a rabbit to run across the road in front of us. He sees it, I see that he sees it, he sees that I see he sees it. Having lived with Hunter for over ten years, I know that I have about two seconds to convince him to remain at heel rather than run after the rabbit. I also know that the outcome will depend in part on how authoritative my voice is, how close the rabbit, how intense the scent, and how bad his arthritis. Most of the time I succeed in convincing him not to run; occasionally I fail. In either case, complex communications take place between us about an external reality that we both perceive and that affects our actions. How does this happen?

No doubt Hunter processes the world in a very different way than I do, from the limited color range he experiences to the vastly richer role scent plays in his universe. Despite these differences, we are able to communicate because we share a context that remains largely consistent from day to day. I do not perceive the world as he does, but my perception of his perception stays relatively constant. I know the kinds of things that excite his attention and what his probable responses will be, just as he knows mine. When the rabbit runs across our path, we each react within our different sensory realms to a stimulus that catalyzes our responses, which are also conditioned by past experiences with the world and each other. This consistency allows for the shorthand "Hunter sees the rabbit," although on reflection I am aware that "rabbit" is an anthropomorphic concept that Hunter does not share with me in anything like the same sense another human being could. The unmediated flux impinges on him, impinges on me; I see the rabbit and Hunter's response in my way, he sees the rabbit and my response in his. We both know that we are responding to an event we hold in common, as well as to a context that includes memories of similar events we have shared.

The temptation to forget the complexities of this account and abstract to the shorthand is very strong. From such abstraction comes the belief that nature operates according to laws that are universally and impartially true. What is the harm in moving to the abstraction? The implications become clear when we look at what it leaves out of account. Gone from view are the

species-specific position and processing of the observer; the context that conditions observation, even before conscious thought forms; and the dynamic, interactive nature of the encounter. In such a pared-down account, it is easy to believe that reality is static and directly accessible, chance and unpredictability are aberrations, and interaction is nothing more than an additive combination of individual factors, each of which can be articulated and analyzed separate from the others.

This is, of course, the world of classical physics. It continues to have a vigorous existence in popular culture as well as in the presuppositions of many practicing scientists. When the TV camera, accompanied by Carl Sagen's voice-over, zooms through the galaxy to explore the latest advances in cosmology, these presuppositions are visually and verbally encoded into an implied viewpoint that seems to be unfettered by limitations of context and free from any particular mode of sensory processing. As a representation, this simulacrum figures representation itself as an inert mirroring of a timeless, objective reality.

Perhaps its most pernicious aspect is the implicit denial of itself as a representation. The denial is all the more troubling because of the ideological implications encoded within it. Among those who have explored these implications is Evelyn Fox Keller, who points out the relation between an "objective" attitude, the masculine orientation of science, and the construction of the world as an object for domination and control; Ilya Prigogine and Isabelle Stenger, who relate the appeal of a timeless realm to a fear of emotional involvement and death; Nancy Cartwright, who demonstrates that the idea of scientific "laws" always derives from the act of analysis and never intrinsically from the situation itself; and Michel Serres, who reminds us that deviations from idealized, abstract forms are not exceptions but the noise that constitutes the world.[8] These critiques can be seen as acts of recovery, attempts to excavate from an abstracted shorthand the complexities that unite subject and object in a dynamic, interactive, ongoing process of perception and social construction.

[8]Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale Univ. Press, 1985); Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* (New York: Bantam, 1984); Nancy Cartwright, *How the Laws of Physics Lie* (New York: Oxford Univ. Press, 1983); and Serres.

A model of representation that declines the leap to abstraction figures itself as species-specific, culturally determined, and context-dependent. Emphasizing instrumental efficacy rather than precision, it assumes local interactions rather than positive correspondences that hold universally. It engages in a rhetoric of "good enough," indexing its conclusions to the context in which implied judgments about adequacy are made. Yet it also recognizes that within the domains specified by these parameters, enough consistencies obtain in the processing and in the flux to make recognition reliable and relatively stable.

Since the claim for consistency separates this position from strict social construction, it is worth exploring more fully. Central to this claim is the idea of constraints. By ruling out some possibilities—by negating articulations—constraints enable scientific inquiry to tell us something about reality and not only about ourselves. Consider how conceptions of gravity have changed over the last three hundred years. In the Newtonian paradigm, gravity is conceived very differently than in the general theory of relativity. For Newton, gravity resulted from the mutual attraction between masses, for Einstein, from the curvature of space. One might imagine still other kinds of explanations, for example a Native American belief that objects fall to earth because the spirit of Mother Earth calls out to kindred spirits in other bodies. No matter how gravity is conceived, no viable model could predict that when someone steps off a cliff on earth, she will remain spontaneously suspended in mid-air. This possibility is ruled out by the nature of physical reality. Although the constraints that lead to this result are interpreted differently in different paradigms, they operate universally to eliminate certain configurations from the range of possible answers. Gravity, like any other concept, is always and inevitably a representation. Yet within the representations we construct, some are ruled out by constraints, others are not.

The power of constraints to enable these distinctions depends upon a certain invariability in their operation. For example, the present limit on silicon technology is a function of how fast electrons move through the semiconductor. One could argue that "electron" is a social construction, as are "semiconductor" and "silicon." Nevertheless, there is an unavoidable limit inherent in this constraint, and it will manifest itself in whatever representation is

used, provided it is relevant to the representational construct. Suppose that the first atomic theories had developed using the concept of waves rather than particles. Then we would probably talk not about electrons and semiconductors, but indices of resistance and patterns of refraction. There would still be a limit, however, on how fast messages could be conveyed using silicon materials. If both sets of representations were available, one could demonstrate that the limit expressed through one representation is isomorphic with the limit expressed in the other.

Note that I am not saying constraints tell us what reality is. This they cannot do. But they can tell us which representations are consistent with reality, and which are not. By enabling this distinction, constraints play an extremely significant role in scientific research, especially when the representations presented for disconfirmation are constrained so strongly that only one is possible. The art of scientific experimentation consists largely of arranging situations so the relevant constraints operate in this fashion. No doubt there are always other representations, unknown and perhaps for us unimaginable, that are also consistent with reality. The representations we present for falsification are limited by what we can imagine, which is to say, by the prevailing modes of representation within our culture, history, and species. But within this range, constraints can operate to select some as consistent with reality, others as not. We cannot see reality in its positivity. We can only feel it through isomorphic constraints operating upon competing local representations.

The term I propose for the position I have been urging is constrained constructivism. The positive identities of our concepts derive from representation, which gives them form and content. Constraints delineate ranges of possibility within which representations are viable. Constrained constructivism points to the interplay between representation and constraints. Neither cut free from reality not existing independent of human perception, the world as constrained constructivism sees it is the result of active and complex engagements between reality and human beings. Constrained constructivism invites—indeed cries out for—cultural readings of science, since the representations presented for disconfirmation have everything to do with prevailing cultural and disciplinary assumptions. At the same time, not all representations will be viable. It is possible to distinguish between them on the basis of what is really there.

Are constraints not themselves representations? If so, how is the claim for their invariability justified? With these questions, the distance between articulation and cusp threatens to collapse, cutting off the connections that interactively put us in touch with the unmediated flux. To answer them and elaborate the dynamic figure of representation, I return to the crucial difference between *congruence* and *consistency*. Congruence implies one-to-one correspondence. In Euclidean geometry, one can test for congruence by putting one triangle on top of another and seeing whether they match. If the area and shape of one exactly fits the other, congruence is achieved; any deviation indicates that they are not congruent. Congruency thus falls within the binary logic of true/false. Consistency, by contrast, cannot adequately be accounted for in a two-valued logic. In addition to true and false, two other positions—let us call them not-true and not-false—are necessary. The introduction of these two values reveals an important asymmetry between affirmation and negation. From this asymmetry emerges a sense of the relation between language and representation that steps outside the reductive dichotomies of the realist/anti-realist debate.
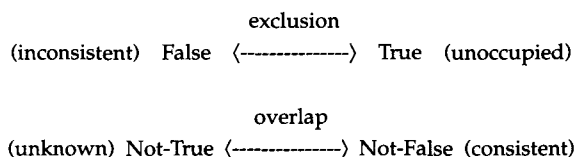
III. The Semiotic Square
and Elusive Negativity

Mapping the four positions mentioned above onto a semiotic square will make explicit the multiple connections and disjunctions that constitute their interactions. A. J. Greimas introduced the semiotic square as a way to represent the possibilities for signification in any semiotic system.[9] These possibilities, although very rich, are not infinite. They are created through the interaction of what Greimas called "semiotic constraints"—deep structures that enable meaning to emerge by restricting articulations to certain axes of signification. Ronald Schleifer has interpreted and expanded on Greimas's construction of the semiotic square, and the discussion that follows is indebted to his work as well as to Greimas.[10]

[9] A. J. Greimas, "The Interaction of Semiotic Constraints," *On Meaning: Selected Writings in Semiotic Theory*, trans. Paul J. Perron and Frank H. Collins (Minneapolis: Univ. of Minnesota Press, 1987) 48-62.

If we grant that we are always already within the theater of representation, it follows that no unambiguous or necessary connection can be forged between reality and our representations. Whatever the unmediated flux is, it remains unknowable by the finite subject. Representations arise in response to such historically specific factors as prevailing disciplinary paradigms and cultural assumptions, as well as such species-specific factors as the human sensorium and neurophysiology. Observations are culturally conditioned and anthropomorphically determined. We can never know how our representations coincide with the flux, for we can never achieve a standpoint outside them. Consequently, the true position cannot be occupied because we cannot verify congruence.

The false position, however, can be occupied. Within the range of representations available at a given time we can ask, "Is this representation *consistent* with the aspects of reality under interrogation?" If the answer is affirmative, we still know only our representations, not the flux itself. But if it is negative, we know that the representation does not adequately account for our interaction with the flux in a way that is meaningful to us in that context. The asymmetry revealed by this analysis should not be confused with Popper's doctrine of falsification.[11] Understanding that theories could not be verified, Popper nevertheless maintained congruence as a conceptual possibility. The problem for him was that congruence was empirically based and so always liable to exceptions that might appear in the future. In the scheme articulated here, future exceptions do not play a privileged role in explaining why congruence cannot be achieved. Even if by some fiat we could be sure that no future exceptions would exist, the most we could say is that a model is consistent with reality as it is experienced by someone with our sensory equipment and previous contextual experience. Congruence cannot be achieved because it implies perception without a perceiver.

The four positions are mapped onto a modified semiotic square as shown below.

exclusion

(inconsistent) False ⟨--------------⟩ True (unoccupied)

overlap

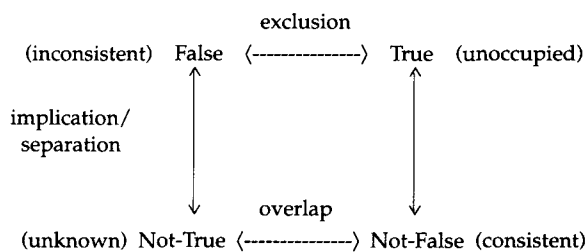(unknown) Not-True ⟨--------------⟩ Not-False (consistent)

The horizontal relation between the two top positions, false and true, is constructed through a contrary relation that makes them mutually exclusive alternatives. What is true cannot be false, and what is false cannot be true. The bottom two positions, not-true and not-false, are in a more complex relation. Not-false, designated as the more restrictive, is occupied by models found to be consistent with the flux as it is interactively experienced. Not-true is occupied by models which have been imperfectly tested or not tested at all; these I call unknown. Between the negated categories of not-false and not-true, two kinds of oppositions are in play. One is a polarity between negation and affirmation (false/true), the other between indefinite and definite (unknown/consistent). This ambiguity folds together the ability to negate with the ability to specify. In doing so, it opens an escape hatch from the prison house of language.

The entanglement of negation with specificity can be explored through the linguistic concepts of modality and marking. Traditionally defined, a modality is a statement containing a predicate that is affirmed or denied by other qualifications. The modern definition expands a modality into any statement about another statement. Non-modal articulations appear as mere statements of fact. In this sense they are unmarked, allowing for a reading that does not take the speaker's position into account. In general, unmarked terms are those which have been naturalized by cultural assumptions and so rendered transparent. "Man" is an unmarked noun, "woman" a marked one; "as old as" is an unmarked phrase, "as young as" a marked one. In modality the marking is accomplished by the qualifying phrase that calls attention to the statement's swerve from facticity. Affirmation and negation are non-modal; denial and assertion are modal. When the President's press secretary says, "The rumor is false [or true]," he has negated [or affirmed] it. When he says, "I say that the rumor is false [or true]," he has denied [or asserted] it. Denial *implies* negation while subtly differing from it, just as assertion *implies* affirmation without exactly being affirmation.

[10]Ronald Schleifer, A. J. Greimas and the Nature of Meaning: Linguistics, Semiotics and Discourse Theory (London: Croom Helm, 1987) 22-55.

[11]Karl L. Popper, Conjectures and Refutations: The Growth of Scientific Knowledge, 2nd ed. (New York: Basic Books, 1965).

As their compound form signals, not-true and not-false are marked terms. Realism tends to elide the differences indicated by these markings, assimilating not-false into true and not-true into false. When a scientific textbook states, "All the matter in the universe was once contracted to a very small area," the difference between the model and the reality tends to disappear, as do the position and processing of the observer for whom the statement makes sense. Far from eliding markings, the semiotic square displays them along the vertical axis. Expanding the binary dichotomy of realism to the quadrangle of semiotics, this distance-as-difference reminds us that articulations emerge from particular people speaking at specific times and places, with all of the species-specific processing and culturally-conditioned expectations that implies. The vertical axis thus separates as well as implicates, as shown in the schematic below.

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                        exclusion
(inconsistent)  False  <--------------->  True  (unoccupied)
                        ^                   ^
implication/            |                   |
separation              |                   |
                        |                   |
                        v     overlap       v
(unknown) Not-True  <--------------->  Not-False  (consistent)
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Beyond the marking that not-true and not-false share is the additional negativity inhering in not-true. Located at the lower left corner of the square, it occupies the space that on a Cartesian grid represents the negative of both axes. The negative of a negative, it is the position most resistant to assimilation into the transparencies of non-modal statements. Fredric Jameson calls it "the place of novelty and of paradoxical emergence," noting that it is "the most critical position and the one that remains open or empty for the longest time."[12]

The implications of its excess negativity can be unpacked by again referring to modality. It is possible to negate a modality, creating as it were a double marking. The press secretary may say, "I cannot say that the rumor is false [or true]," in which case the status of the rumor remains indeterminate. This situation corresponds to a residue within the not-true position that cannot be articulated—models that we cannot conceive

because they are alien to our mode of processing the world. Not coincidentally, it also points to the reason why we cannot say a model is congruent with reality. Because we can never achieve a viewpoint outside our viewpoint, "unknown" overlaps with and implies "unknowable."

Schleifer has argued that this kind of ambiguous negation is characteristic of scientific theories and art forms that elude either/or categorization, particularly quantum mechanics and literary modernism.[13] Shoshana Felman has called it "radical negativity," which "belongs neither to *negation*, nor to *opposition*, nor to *correction* . . .—it belongs precisely to *scandal*."[14] Calling this scandal the "outside of the alternative" because it emerges from a "negativity that is neither negative or positive" (141-42), she suggests that it opens the way to reconceive referentiality (76-77). In my terms, it allows the question of reference to be re-introduced without giving up the insights won by the new sociology of science when it bracketed reference.

The relation of constraints to representation can now be articulated more precisely. When constraints become representations, they necessarily assume a positive cognitive content that moves them from the cusp into the theater. When I say, "The total entropy of a closed system never decreases," I am expressing a representation of a constraint. Representations of this kind operate along the diagonal that connects inconsistent and consistent models. At the cusp, the interactions expressed by these representations have no positive content. The inability of language to specify these interactions as such is itself expressed by the elusive negativity that exists within the not-true position. The diagonal connecting true and not-true reveals their common concern with the limits of representation. At the positive ("true") end of the diagonal, the limits imply that we cannot speak the truth. At the negative ("not-true") end, they paradoxically perform the

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[12]Fredric Jameson, foreword, *On Meaning* xvi.

[13]Ronald Schleifer, "Analogy and Example: Heisenberg, Negation, and the Language of Quantum Mechanics," unpub. ms. See also Ronald Schleifer, *Rhetoric and Death: The Language of Modernism and Postmodern Discourse Theory* (Champaign: Univ. of Illinois Press, 1990).

[14]Shoshana Felman, *The Literary Speech Act: Don Juan with J. L. Austin, or Seduction in Two Languages*, trans. Catherine Porter (Ithaca: Cornell Univ. Press, 1983) 141-42.

positive function of gesturing toward that which cannot be spoken. Elusive negativity, precisely because of its doubly negative position, opens onto the flux that cannot be represented in itself.

The complete semiotic square can now be given.
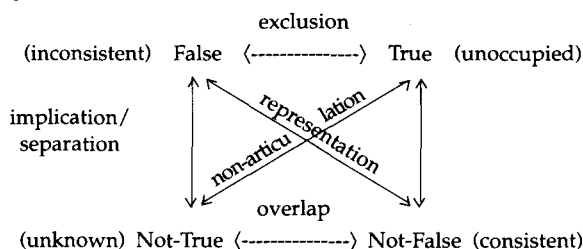
It is no accident that the semiotic constraints generating the semiotic square bring the not-true position into view. Language structures how we conceptualize any representation, including mathematical and scientific ones. But language is not all there is. Elusive negativity reveals a synergy between physical and semiotic constraints that brings language in touch with the world. Physical constraints, by their consistency, allude to a reality beyond themselves that they cannot speak; semiotic constraints, by generating excess negativity, encode this allusion into language. There is a correspondence between language and our world, but it is not the mysterious harmony Einstein posited when he said that the mystery of the universe is that it is understandable. Neither is it the self-reflexivity of a world created through language and nothing but language. Our interactions with the flux are always richer and more ambiguous than language can represent. Elusive negativity, acknowledging this gap, gestures toward this richness and so provides a place within semiotic systems to signify the unspeakable—to signify the cusp.

IV. Making Connections: The Language of Metaphorics

To posit a model for scientific inquiry is to presuppose or evoke a correlative view of language. A realistic model calls for and is reinforced by the assumption that language is a transparent medium transmitting ideas directly from one mind to another; a positivist model produces and is produced by attempts to formalize language into theory and observation components; a social constructivist model is associated with a non-referential view of

language that sees discourse operating through relations of sameness and difference. These correspondences are not accidental. They must obtain in any coherent account of scientific inquiry, for inquiry is constituted as such only when it enters the social arena of discourse. Like other representations of scientific inquiry, constrained constructivism corresponds to a particular view of language. The view of language correlative with it can be found within the emerging field of metaphorics. The difference between a representation consistent with reality and one that depicts reality is the difference between a metaphor and a description. Constrained constructivism thus implies that all theories are metaphoric, just as all language is. Metaphorics, defined as the systematic study of metaphoric networks as constitutive of meaning production, presents a view of scientific inquiry that enriches and implies the figure of representation presented here.

Since Max Black's influential analysis of metaphor, it has become customary to emphasize the power of metaphor to create new understanding.[15] According to this argument, metaphors not only express similarities between disparate concepts; they also set up complex currents of interaction that change how the terms brought into relation are understood.[16] A similar argument is adopted by Lakoff and Johnson in *Metaphors We Live By*.[17] Like Black, Lakoff and Johnson are concerned with systems of associated commonplaces that infuse into each other when two terms are brought into metaphoric interplay. Their emphasis falls on ordinary metaphors which, precisely because they do not surprise, reveal presuppositions deeply embedded within the culture.

In Arbib and Hesse's *The Construction of Reality*, metaphorics is explicitly connected with scientific inquiry.[18] They argue that perception takes place through schema which operate

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[15]Max Black, *Models and Metaphors* (Ithaca: Cornell Univ. Press, 1962). See also "More About Metaphor," *Metaphor and Thought*, ed. Andrew Ortony (Cambridge: Cambridge Univ. Press, 1979) 19-43.

[16]Paul Ricoeur emphasizes the torque that metaphors put on terms in *Interpretation Theory: Discourse and the Surplus of Meaning* (Fort Worth: Texas Christian Univ. Press, 1976).

[17]George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: Univ. of Chicago Press, 1980).

through relational similarities and differences. The category "dog" has as its reference not some Platonic idea that captures the essence of dog, but a network of individual perceptions that form a group, albeit one fuzzy at the edges. In their account, the tension between similarity and difference characteristic of metaphor, far from being a special subset of language usage, is fundamental to how language works. The "loose bagginess" of the metaphoric relation allows for constantly changing configurations within metaphoric networks; these changes in turn correlate in a systematic fashion with shifts in paradigms. "Scientific revolutions," Arbib and Hesse write, "are, in fact, metaphoric revolutions, and theoretical explanation should be seen as metaphoric redescription of the domain of phenomena" (156).

In James J. Bono's account, metaphorics allows cultural presuppositions to be articulated together with scientific discourse systems.[19] Bono argues that metaphor functions "as both the site and means for exchanges among not only words or phrases, but also theories, frameworks, and most significantly, discourses" (73). He envisions interactive, synchronic networks of metaphors that span disciplinary boundaries, in which traces of metaphors inherited diachronically from disciplinary traditions interfere and intersect with other metaphoric systems within the culture. Meaning production in this account can never be contained within a scientific field alone. Rather, it depends upon and emerges from resonances and interferences between inter- and extra-scientific networks of metaphors that engage one another at highly specific sites.

Constrained constructivism matches these views of scientific language with an interactive, dynamic, locally situated model of representation. Recognizing that scientific theories operate within the theater of representation, it emphasizes that meaning production is socially and linguistically constructed. The elusive negativity that is a consequence of taking consistency rather than congruence as a standard for correctness reveals ambiguities intrinsic to any account of scientific models.

These ambiguities ensure fluidity in language, thus reinforcing the claim that scientific revolutions are effected through metaphoric redescription. Finally, the transformative nature of interactions at the cusp makes the model context-dependent as well as species-specific, encouraging the idea that specific exchanges take place at local sites. Constrained constructivism thus presents a figure of representation that itself can be a metaphor for the inquiries of metaphorics.

V. Situated Knowledge: No Outside but a Boundary

Constrained constructivism puts limits on Derrida's aphorism that there is no outside to the text. Although there may be no outside that we can know, *there is a boundary*. The consequences that flow from positing a boundary or cusp rescue scientific inquiry from solipsism and radical subjectivism. At the same time, constrained constructivism acknowledges that we cannot have direct, unmediated access to reality. There is much to be said on why this acknowledgement is felt as an intolerable limitation by some realists. In "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," Donna Haraway alludes to the ideology embedded within an omniscient viewpoint when she calls it a "god trick."[20] Objectivity is associated with a view from everywhere, and hence from nowhere—a view with no limitations and hence no connections to humans located at specific places and times.[21] That it is a power trip is undeniable. That this power has frequently been misused is also undeniable. The illusion that one can achieve an omniscient vantage point, and the coercive practices associated with this illusion, have been so thoroughly deconstructed that they do not need further comment here. The liberatory spirit with which the critiques of objectivity were undertaken has been realized in the valuable contributions they have made to our understanding of how ideology and scientific objectivity mutually reinforce each

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[18]Michael A. Arbib and Mary B. Hesse, *The Construction of Reality* (Cambridge: Cambridge Univ. Press, 1986) 147-70.

[19]James J. Bono, "Science, Discourse, and Literature: The Role/Rule of Metaphor in Science," *Literature and Science: Theory and Practice*, ed. Stuart Peterfreund (Boston: Northeastern Univ. Press, 1990) 59-89.

[20]Donna Haraway, "Situated Knowledges: The Science Question in Feminism as a Site of Discourse on the Privilege of Partial Perspective," *Feminist Studies* 14 (1988): 575-99.

[21]For a different (and more realist) position on how subjectivity and objectivity can be integrated, see Thomas Nagel, *The View from Nowhere* (New York: Oxford Univ. Press, 1986).

other.

But in the process, objectivity of any kind has gotten a bad name. I think this is a mistake, for the possibility of distinguishing a theory consistent with reality from one that is not can also be liberating. If there is no way to tell whether the claim that blacks and women have inferior brains is a less accurate account of reality than the claim that they do not, we have lost a valuable asset in the fight for liberation. George Levine eloquently made this point when he argued for the need to break out of coterie politics and strive for a faithful account of reality.[22] Donna Haraway also recognizes this possibility when she calls for a paradoxical, non-innocent stance that will recognize limited objectivity at the same time that it continues to deconstruct all claims to omniscient knowledge. The problem she wrestles with is underscored by Levine as the central issue of the contemporary sociology of knowledge: "how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own 'semiotic technologies' for making meanings, *and* a no-nonsense commitment to faithful accounts of a 'real' world, one that can be partially shared and that is friendly to earthwide projects of finite freedom, adequate material abundance, modest meaning in suffering, and limited happiness" ("Situated Knowledges" 579).

Haraway's solution is to emphasize that every perspective is partial, all knowledges situated.

She tackles the difficult task she sets herself by continuing the vision metaphor but insisting that it is partial and contingent rather than full and unlimited. I am fully in sympathy with her project, and I think that she has articulated the central problem that a feminist sociology of knowledge faces. I am concerned, however, that the idea of partial vision can be easily misconstrued. It can be taken to suggest that part of our vision sees things as they really are, while only part is obscured. Whatever our vision is, this is not the case; we see things whole, not in parts. An alternative approach is to follow the lead of Merleau-Ponty when he suggests that situatedness, far from being a barrier to knowledge, enables it.[23] Given that we are not God, we can only come in touch with the universe through particular sets of sensory apparatus located within specific cultures and times. Constrained constructivism has this double edge: while it implies relativism, it also indicates an active construction of a reality *that is meaningful to us* through the dynamic interplay between us and the world. Renouncing omniscience and coercive power, it gains connectedness and human meaning.□

[23]Merleau-Ponty, *The Phenomenology of Perception* (London: Routledge & Kegan Paul, Ltd., 1962).

N. Katherine Hayles, Carpenter Professor of English at the University of Iowa, writes and teaches on literature and science in the twentieth century. Her most recent books are Chaos Bound: Orderly Disorder in Contemporary Literature and Science *(Ithaca: Cornell University Press, 1990) and an edited collection of essays,* Chaos and Order: Complex Dynamics in Literature and Science *(Chicago: University of Chicago Press, forthcoming 1991).*

[22]George Levine, Plenary Address at the Society for Literature and Science Conference, Sept. 1988.

Bruce Clarke

RESISTANCE IN THEORY AND THE PHYSICS OF THE TEXT

The rhetoric of "resistance" is prominent in contemporary theory: postmodern discourses often vie for the distinction of being considered "sites of resistance." Resistance is arguably the global trope of theory at the present moment. That this concept can bear such a totalizing description brings out the political and discursive problems I want to explore in this essay. How is the rhetorical operator "resistance" related to analogous physical and theoretical constructs such as friction, noise, and turbulence? How is resistance related to metaphor, when metaphor is also a trope of resistance? By deferring and problematizing signification, the metaphor means by resisting meaning.[1] Thus "resistance" as appropriated by a literary discourse is a sedimented and self-reflexive construct, a second-order figure, a metalepsis or catachresis, the trope of a trope.[2] This complex trope and its cultural and physical isomorphs are deeply inscribed in postmodern literary and scientific theory.

"Resistance" is a dynamic phenomenon produced by a relational function. Resistance is the act, power, or capacity of opposing or withstanding, but for resistance to occur there must be two bodies or forces in opposition, and the resistance may be manifested by either, or both. For instance, deployed in a political context, "resistance" can name either a radical opposition—active or passive resistance to given power structures and forces—or a "reactionary" intransigence—resistance to change or reform. Hal Foster has distinguished between "a postmodernism which seeks to deconstruct modernism and resist the status quo and a postmodernism which repudiates the former to celebrate the latter, a postmodernism of resistance and a postmodernism of reaction."[3] The problem is of course that resistance is inherently reactive—the very concept is predicated on the counter-presence of an antagonist—and thus to distinguish "political resistance" from "political reaction" is a serviceable polemical gambit but not a stable description.

Still, the new scientific paradigms are making us more comfortable with unstable descriptions, for instance, those in which a fractal scaling produces rapid shifts between relatively local and global perspectives. In the thematic politics of contemporary theory, the terms "local" and "global" run in parallel with the rhetoric of resistance, in variations upon the following formula: the global is total and weighs upon the local, but the local is differentiated and resists the global. N. Katherine Hayles has thought deeply into these issues, and arrived at some unsettling conclusions: "Concerned to resist totalization, postmodern theories image and enact a totalization more complete than any that came before. . . . Chaos theory has a double edge, at once celebrating chaos's resistance to rationalization and striving to overcome this resistance" (CB xiv, 140).

Perhaps the question, at least in large and equivocal form, comes down to this: can resistance in fact be overcome? Can chaos be bound, and if so, should it be? The current shifts in literary and scientific thinking about resistance differ from much previous thinking in that they do not entail an exclusionary valorizing of either side of a complex phenomenon of resistance. Rather, because it has become clear that resistances inextricably saturate and inform any material or cultural process, they call for a relinquishing of the futile imperative to eliminate resistances. What is needed, it is thought, is not the abolition but the appreciation of resistances, the reading and reordering of resistances as information about differences.

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[1] "De Man wants rhetoric not only to resist grammar but to resist it irresistibly. . . . Rhetoric [is for de Man the] symbol and figure of resistance," N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca: Cornell Univ. Press, 1990) 229; hereafter abbreviated in the text as *CB*.

[2] See Peter de Bolla, *Harold Bloom: Towards Historical Rhetorics* (New York: Routledge, 1988) 119-43.

[3] "Postmodernism: A Preface," in *The Anti-Aesthetic: Essays on Postmodern Culture*, ed. Foster (Port Townsend, Wash.: Bay Press, 1983) xi-xii.

It may be that the irresistible theoretical appeal of resistance is that it serves a global function: it is the signature effect of the (bio)physics of structures. It is a postmodern truism that the body is the site of resistance: the implicit reflex of that assertion is that resistance is the site of the body. As there are different phases of materiality, so there are forms of solid resistance out of phase with the forms of fluid resistance. The transition from order to chaos has often been modeled by the shift in interest from the solidity of Euclidean and Newtonian masses to the physics of fluids and the fluidity of informational streams. Perhaps the solid/fluid dyad can provide a useful tool for the discrimination of resistances at large in literary and scientific theory.

Architecture

John Ruskin's *The Stones of Venice* (1851-53) presents not only a lively application of the concept of solid resistance to architectural construction, but also an exemplary traditional model of tendentious analogizing, the sliding of the concept of resistance from a material to a spiritual application. In the following passage, Ruskin's Victorian analogues between physical and moral gravity, his dialect of "character structure," fleshes out the old cliché about moral uprightness as "backbone":

> VI. Now the arch line is the ghost or skeleton of the arch; or rather it is the spinal marrow of the arch, and the voussoirs [arch stones] are the vertebrae, which keep it safe and sound, and clothe it. This arch line the architect has first to conceive and shape in his mind, as opposed to, or having to bear, certain forces which will try to distort it this way and that; and against which he is first to direct and bend the line itself into as strong resistance as he may, and then, with his voussoirs and what else he can, to guard it, and help it, and keep it to its duty and its shape. So the arch line is the moral character of the arch, and the adverse forces are its temptations; and the voussoirs, and what else we may help it with, are its armour and its motives to good conduct.
> VII. This moral character of the arch is called by architects its 'Line of Resistance'. There is a great deal of nicety in calculating it with precision, just as there is sometimes in finding out very precisely what is a

man's true line of moral conduct.[4]

This Masonic "morality"—the structural need to conserve the energy expended in erecting a vertical disequilibrium between stacked stones and the force of gravity—is a striking example of the conservative or defensive use of the notion of resistance. Temptation rains down on the upright character as relentlessly as gravity tugs at the rooftiles of a cathedral. Moral characters constructed on such architectural models will not be very supple, will collapse in a spectacular crash if they crack at all. "Solid resistance" is often invoked in what we might term the "reactionary morality" of global structures, in this case, the British imperial psyche.

Psychoanalysis

In classical psychoanalytical theory, "resistance" is a well-elaborated concept expressing the conservatism of the ego-defenses, the obsessive investments neurotics make in the structures of their neurosis: "When we undertake to restore a patient to health, to relieve him of the symptoms of his illness, he meets us with a violent and tenacious resistance, which persists throughout the whole length of the treatment."[5] Freud's particular insights were to conceptualize resistance as such and to factor it into therapy; here is not a meaningless inertia but a therapeutic sign: "we come finally to understand that the overcoming of these resistances is the essential function of analysis" (291). The shape of the resistance is relatively fixed and indicates the path analysis must take. The analyst must provoke that resistance, must first construct that solid wall, and then surpass it. The proper analytical resistance to the analysand's resistance is not solid but fluid: it must interpret and rewrite neurotic resistance, turn opaque static into psychological meaning and movement.[6]

Literary Theory

Thus when Paul de Man meditates on the "resistance to theory" at large in the field of literary study, he treats a term transferred from

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[4]*The Stones of Venice* (London: Waverly, n.d.) 1: 128-29.

[5]Sigmund Freud, *Introductory Lectures on Psychoanalysis*, trans. and ed. James Strachey (New York: Norton, 1977) 286.

physics and technology and saturated with ethical, political, and psychoanalytical connotations. "It may well be," he speculates, "that the polemical opposition, the systematic non-understanding and misrepresentation, the unsubstantial but eternally recurrent objections [to theory], are the displaced symptoms of a resistance inherent in the theoretical enterprise itself."[7] In this rhetorical transference, the "displaced symptoms" the literary analyst must translate into insights about unconscious structures refer to the unconscious of the (Anglo-American) literary academy, as it were: language itself in its linguistic dimension, language considered "as a system of signs and of signification rather than an established pattern of meanings" (de Man 9). For de Man, the resistance to literary theory is a resistance to any systematic acknowledgement of "the materiality of the signifier" (11).

Once literary study becomes a material mechanics of both the production and the reception of texts, it is prepared for treatment by dynamical systems theory. In line with the "dripping faucet" physics of chaos theory, de Man's literary or readerly resistance is a material phenomenon produced by the physics of textuality and the stochastic swerve of the trope. "It may well be . . . that the development of literary theory is itself overdetermined by complications inherent in its very project and unsettling with regard to its status as a scientific discipline. Resistance may be a built-in constituent of its discourse, in a manner that would be inconceivable in the natural sciences and unmentionable in the social sciences" (de Man 12). In fact, chaos theory has placed a calculus of resistance within the natural sciences by showing that its inconceivability until recently (with the advent of the computer) was an inability to calculate the true complications of the friction and drag that render physical systems nonlinear and so recalcitrant to a linear science that founded its perfection on the ideally frictionless dynamics of celestial mechanics.

Information Theory

Literary theory for de Man "contains a necessarily pragmatic moment that certainly weakens it as theory but that adds a subversive element of unpredictability and makes it something of a wild card in the serious game of the theoretical disciplines" (8).[8] This "necessarily pragmatic moment" is bound up with the linguistic imperative of poststructuralist theorizing. To some extent, de Man models literary theory after a "hard science," naming, like elements or molecules, the structural constraints of the discipline, constraints that dynamize rather than limit meanings: the materiality of the signifier, the rule of metonymy, and the productive function of random or unpredictable processes, as that has recently been conceived in information theory.

William R. Paulson has developed a theory of literature modeled, after Michel Serres, on the telecommunications concept of noise (le parasite): "literary communication assumes its noise as a constitutive factor of itself."[9] Summarizing the thesis of de Man's "The Resistance to Theory," Paulson explicitly connects the topics of resistance and noise. Another way of expressing this analogue is that "noise" is the trope of resistance as applied to the technology of communication:

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[6]Psychoanalytical literary criticism has found resistance to be a powerful way to articulate the unconscious dynamics of a text. For instance, Thomas Weiskel advanced a large thesis about Wordsworth's creativity in the following formulation: "Hence the signifier may be misconstrued in two possible ways. It may be simply misread, or—and this is the point with Wordsworth—there may be a resistance or a barrier to its recognition as a signifier, a resistance to reading itself as opposed to a resistance to seeing. I think the resistance may be identified with what Wordsworth calls imagination" (*The Romantic Sublime: Studies in the Structure and Psychology of Transcendence*, 2nd ed. [Baltimore: Johns Hopkins Univ. Press, 1986] 175). Leo Bersani provides another example: "I wish to examine texts that propose and that resist the following proposition: sexual excitement and even sexual violence are functions of mimetic representations. . . .The theoretical turbulence of Freud's essay on Leonardo can perhaps be traced to Freud's resistance to the implications of his traumatic (maternal) model of sexuality" ("Representation and its Discontents," in *Allegory and Representation*, ed. Stephen J. Greenblatt [Baltimore: Johns Hopkins Univ. Press, 1981] 145, 157).

[7]"The Resistance to Theory," *The Resistance to Theory* (Minneapolis: Univ. of Minnesota Press, 1986) 12. Hayles' analysis of "The Resistance to Theory" focuses on the problematics of totalization and mastery in de Man's text (*CB* 227-32).

[8]For another view of the epistemology of theory, see Paisley Livingston, *Literary Knowledge: Humanistic Inquiry and the Philosophy of Science* (Ithaca: Cornell Univ. Press, 1988).

[9]*The Noise of Culture: Literary Texts in a World of Information* (Ithaca: Cornell Univ. Press, 1988) 83.

The most subtle resistance to theory thus resides in the most sophisticated of the literary theories that are committed to the resolution of textual uncertainties through grammatical or hermeneutic models. These theories aim, in effect, at an eventual reduction of the noise in the literary channel by ever more sophisticated understanding of codes and formation rules. As useful as this task is, its considerable successes tend to mask what is most irreducibly literary about certain linguistic messages: the fact that what is received cannot coincide with what is sent, that there is, in other words, noise in the channel.

(84)

Noise is the sum of all material resistances to the transmission of information. For Paulson, the literary text above all is a communication that resists its own transmission, and yet creates itself through that same resistance. Literary noise—the music of the material medium—turns into a significant interruption creative of new information.

De Man contends that "tropes pertain primordially to language. They are text-producing functions that are not necessarily patterned on a non-verbal entity, whereas grammar is by definition capable of extra-linguistic generalization. The latent tension between rhetoric and grammar precipitates out in the problem of reading, the process that necessarily partakes of both. It turns out that the resistance to theory is in fact a resistance to reading" (15). Tropic resistance produces noise to the extent that it interrupts or defers the possession of an immediately unequivocal quantum of semantic information. At the same time, by that resistance to univocal sense, by obviating the trivial and redundant, the trope produces literary complexity.[10] Thus, at the price of the risk of gross misprision, tropes place readers in positions to generate new information.

And it is on this turn from meaningless to significant disorder that the theory of information flows into the theory of chaos. For chaos, like noise, if observed from the right position, generates form. No analogical leap is necessary to make this passage: as Hayles has observed, "a transformation within the information perspective . . . occurred when information ceased to be thought of as inherently structured and became associated with randomness. Given the forces already at work within the culture that privileged information, this shift authorized a reevaluation of chaos."[11]

Chaos Theory

Material resistance is indispensable to the fractal dynamics of open, driven, and damped systems, which play themselves out between the accumulation and the dissipation of energy. James Gleick invokes "the demon of nonlinearity" in a discussion of friction: "Nonlinearity means that the act of playing the game has a way of changing the rules. You cannot assign a constant importance to friction, because its importance depends on speed. Speed, in turn, depends on friction. That twisted changeability makes nonlinearity hard to calculate."[12] A calculus of resistance was absent from classical and Newtonian physics, which modeled periodic linear dynamics on celestial mechanics, where friction is immediately negligible. In this light, Newtonian physics is extraterrestrial physics for solid bodies in motion in an ideal Euclidean void: the motions of bodies in space are predictable because at the scale of the solar system, they occur relatively free of weight, friction, drag, and turbulence, all the fluid dynamics of earth-bound systems.[13]

In chaos theory, reconceptions of friction and dissipation are in concert with Shannon's revaluation of "entropy" as a measure of information: "To Robert Shaw, strange attractors were engines of information. In his first and grandest conception, chaos offered a natural way of returning to the physical sciences, in

[10]"Rhetorical devices, local departures from the degree zero, imply a reduction of predictability: the rhetorical deviation (*écart*) diminishes redundancy" (Paulson 64). Another way of stating this is that the trope promotes message-entropy: "the rhetorical device, then, goes against the usual rules of predictability, but does so in an environment where sufficient redundancy remains so that the departure from the norm is nonetheless intelligible. In this sense, the rhetorical device is part of Lotman's h_2 function: an increase in entropy (unpredictability) and hence a decrease in redundancy by virtue of a language's capacity to say something in more than one way" (Paulson 65).

[11]"Chaos as Orderly Disorder: Shifting Ground in Contemporary Literature and Science," in *NLH* 20.2 (Winter 1989): 305.

[12]*Chaos: Making a New Science* (New York: Penguin, 1987) 24.

reinvigorated form, the ideas that information theory had drawn from thermodynamics" (Gleick 258). Information theory, chaos theory, and deconstruction each provide post-Newtonian calculuses for the residues of material resistance in natural and artificial systems, like bodies and texts. They discover that such residues are not negligible, but rather pervasive, determining as well as determinate, and ineradicable. What friction is to physical systems, what noise is to the transmission of information, de Man's "resistance" is to the physics of the text: "a residue of indetermination" (15).

Nonlinearity emerges in literary theory as the displacement and potentially infinite deferral of the signified produced by any poetic or narrative figure. But although the signified may slide away from the signifier, the tenor abscond from the vehicle, they do not do so without some friction. Perhaps we will discover that in the physics of the text, there is a strange attractor for every metaphor. Or perhaps, by modeling literary inquiries on the new sciences that have excavated the strange attractor from the discarded residues of classical rationality, we will identify more powerfully the sites from which the noise of the text produces maximal information.

Feminism

Perhaps the most apt material analogue for a physics of textuality is not solid but fluid dynamics, not stable linear trajectories but creative nonlinear turbulence.[14] In a feminist psychoanalysis of physics, "The 'Mechanics' of Fluids," Luce Irigaray states:

It is already getting around—at what rate? in what contexts? in spite of what resistances?—that women diffuse themselves according to modalities scarcely compatible with the framework of the ruling symbolics. Which doesn't happen without causing some turbulence.[15]

Irigaray argues that classical science is a male-gendered system that has modeled itself not only on the ideal of phallic linearity—predictable, frictionless celestial trajectories—but also and more fundamentally on the (meta)physics of solids: "What structuration of (the) language does not maintain a *complicity of long standing between rationality and a mechanics of solids alone?*" (107). As a result, "historically the properties of fluids have been abandoned to the feminine" (116). Thus the inability until recently to account for complex nonlinear dynamics has also meant as a cultural effect that the "feminine" has been relegated to the realm of the chaotic, the noisy, the resistant, and the unpredictable, where it has suffered moral absolutisms as if they were physical laws.[16]

Now if we examine the properties of fluids, we note that this "real" may well include, and in large measure, *a physical reality* that continues to resist adequate symbolization and/or that signifies the powerlessness of logic to incorporate in its writing all the characteristic features of nature. And it has often been found necessary to minimize certain of these features of nature . . . so as to keep it/them from jamming the works of the theoretical machine.

(Irigaray 106-7)

Irigaray's meditation on the gender-structuration of classical physics echoes the focus—in chaos theory as well as in Michel Serres' exposition of Lucretius—on fluid dynamics, where resistance becomes especially

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[13]Gleick gives short shrift to the work of Prigogine, a pioneer in the current understanding of dissipative structures. See the account of the history of science in Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* (Boulder, Colo.: New Science Library, 1984). Hayles sorts all this out in *Chaos Bound*: on Gleick (*CB* 171-75), on Prigogine and Stengers (*CB* 91-114). Hayles also points out that Newtonian mechanics eventually foundered on the nonlinearity of the "three-body problem," the insolubility of which by linear means was proven by Poincaré in 1890 (*CB* 1-2).

[14]"Pockets of turbulence scattered in flowing fluid, be it air or salt water, breaking up the parallelism of its repetitive waves. The sweet vortices of the physics of Venus" (Michel Serres, *Hermes: Literature, Science, Philosophy,* eds. Josué V. Harari and David F. Bell [Baltimore: Johns Hopkins Univ. Press, 1982] 100-1).

[15]*This Sex Which Is Not One,* trans. Catherine Porter with Carolyn Burke (Ithaca: Cornell Univ. Press, 1985) 106.

[16]Cf. Hayles' analysis of the feminine as "other" in chaos science: "Chaotic unpredictability and nonlinear thinking . . . are just the aspects of life that have tended to be culturally encoded as feminine. . . . Chaos itself has often been depicted as female. . . . The complex play of gender, individuality, and scientific theory in Gleick's text suggests that chaos theory is a deeply fissured site within the culture" (*CB* 173-74).

complex and chaos goes under the name of turbulence. Traditional physics found fluids to be problematic: recalcitrant, unpredictable, and unstable.[17] But turbulence is the form- and information-generating noise of fluid dynamics. Relative to the Euclidean geometry of solids, fluid dynamics are inherently fractal: "the equations of fluid flow are in many contexts dimensionless, meaning that they apply without regard to scale" (Gleick 108).[18]

Irigaray is strategically ambivalent about the analogy between femininity and fluid dynamics. On the one hand, it may merely express masculine incomprehension of and desire for dominance over the feminine: Irigaray comments that woman has been peremptorily assigned "her 'fluid' character, which has deprived her of all possibility of identity with herself within such a [masculine] logic [of solids]" (109). But on the other hand, insofar as the behaviors of both females and fluids have been systematically demoted in masculine rational economies as insignificant resistances, she seems to celebrate the receptivity as well as the recalcitrance of fluidity as essentially feminine:

> The woman-thing . . . speaks "fluid" . . . . It is continuous, compressible, dilatable, viscous, conductible, diffusible, . . . it enjoys and suffers from a greater sensitivity to pressures . . . it changes—in volume or in force, for example—according to the degree of heat . . . it is, in its physical reality, determined by friction between two infinitely neighboring entitites—dynamics

of the near and not of the proper . . . it allows itself to be easily traversed by flow by virtue of its conductivity to currents coming from other fluids or exerting pressure through the walls of a solid . . . it mixes with bodies of a like state, sometimes dilutes itself in them . . . and furthermore . . . it is already diffuse "in itself," which disconcerts any attempt at static identification.

(111)

Irigaray expresses a certain feminist resistance to the peremptory assignment and predictable replication of arbitrarily gendered qualities; at the same time she describes a liberation of the fluid possibilities of the feminine outside the phases of masculine solid economies. Perhaps we see in this polyvalent resistance something of what Ilya Prigogine and Isabelle Stengers note in their discussion of Michel Serres: "The science of analysis and of separation must henceforth, as Serres says, *becalm itself, feminize itself, erase itself,* with observation disappearing in favor of relation."[19]

Introducing gender into these considerations of "resistance" and blurring the locally feminine into the globally resistant could well lead to essentializing aberrations on the order of Ruskin's "moral character of the arch." Nevertheless, that the feminine/fluid analogy offers itself from within a radical feminist discourse perhaps tells us something about the politics of discursive isomorphism: such conceptual plays need to be ventured and exploited for the connections they make possible and the provisional amplifications they produce, at the particular moments of their formulation and reception. One entertains such analogues not as stable identities, but as experimental heuristic moves in an open dialogue.

To venture an isomorphic leap from Irigaray's discourse to the new sciences: if feminism is the noise of patriarchy, the unpredictable turbulence within patriarchy's system of coded transmissions, then chaos theory seems to write the "feminine" back into the "real." Chaos theory is, or could be, feminism for physics. Whether the scientific community will seize this moment in all its implications is perhaps doubtful. Still, the most profound implications of nonlinear science as well as of deconstructive criticism may be the

[17] The *OED* offers the following citation: "1797 *Encycl. Brit.* (ed. 3), XVI 92/2 Of all the resistances of bodies to each [other], there is . . . none of greater importance than the resistance or reaction of fluids." Cf. Gleick: "What is turbulence then? It is a mess of disorder at all scales, small eddies within large ones. It is unstable. It is highly dissipative, meaning that turbulence drains energy and creates drag. . . . Turbulence is like white noise, or static" (122).

[18] As meteorologist and chaos pioneer Erward Lorenz remarked about the first strange attractor, which he happened upon by attempting to model the fluid flow of the atmosphere: "We see that each surface is really a pair of surfaces . . . and we finally conclude that there is an infinite complex of surfaces, each extremely close to one or the other of two merging surfaces" (Gleick 141). This description of the "folding" of chaotic motion clearly echoes Irigaray's formula for the fluid dynamics of the feminine: "dynamics of the near and not of the proper ."

[19] "Postface: Dynamics from Leibniz to Lucretius," in Serres 151.

recovery of the "feminine" residues of resistant materiality within the paradigms of a reformulated scientific and critical rationality, a post-masculine rationality that establishes relations with rather than annihilates that which resists it.

Resistance to Chaos?

In *Chaos Bound*, Hayles acknowledges the revolutionary implications of the new scientific paradigms, but offers sober and important cautionary remarks concerning constraints, and places limits to the application of these physical paradigms to textual, social, and political structures.[20] Hayles' title must be read on the model not of "homeward bound" but of *Prometheus Bound*. If Hayles resists chaos at the same time that she engages it, she shows herself to be a worthy and constructive adversary of this postmodern Titan.[21] She does not maintain the "value-neutrality" of the new sciences; rather, her well taken concern is for the value-ambivalence of any system of rationality. The science of chaos could have the demonic potential of any other "hard science" or technology. Hayles underscores the thrust toward totality within chaos science: "The universalizing impulse within chaos theory is hard to miss" (*CB* 215). Her main exhibit is Mitchell Feigenbaum's "Universality Theory" and the ways that iterative processes have "the effect of overwhelming individual differences between functions" (*CB* 154). I will argue briefly that chaos is not bound by Feigenbaum's universality.

Feigenbaum discovered that the period-doubling scenarios common to phenomena undergoing the transition from order to chaos unfold according to a "universal constant" of 4.669, and is justly lauded for having grasped a

new kind of *pi*.[22] However, if I have grasped the results of his work, Feigenbaum's universality concerns only the transformation into chaos, not the dynamics of chaos proper. Feigenbaum's function does not determine and cannot predict a system's behavior once it has crossed the threshold into chaos: it is rather a measure of the phase transition between order and chaos, an insight into the universal conditions of chaotic origination. Once chaos is the case, local conditions cease to be "universally" predictable, and the global relinquishes its absolutist claims. This universally orderly release from identical replication and hierarchical order can still inspire in "moralists" of chaos like myself visions of chaotic liberation from the linear ratios of globalizing systems.

In my estimation, then, the universality of period-doubling scenarios is secondary to the constrained unpredictability of the chaotic dynamics so produced. H.-O. Peitgen and P. H. Richter have issued their own cautions about overemphasizing the "totalizing" quality of Feigenbaum's universality:

> This universality should not be misconstrued. There are, of course, other paths to chaos; indeed, other scenarios of equally general character have been discovered. The notion of universality in part reflects a tendency of physicists and mathematicians to borrow words that sound important. What is meant is that a certain behavior is *typical* and is more or less surprisingly found in a variety of systems. . . . The Mandelbrot set embodies a principle of the transition from order to chaos more general than the Feigenbaum universality.[23]

In fact, the scaling of fractal objects, the dynamics of complex systems, discover everywhere incremental differences in a universe of unique and unpredictable similarities, recurrences that are nonidentical and unpredictable, always infinitesimally

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[20]Hayles thereby separates herself from, for instance, Michel Serres' willingness to call a morbid form of science morbid and to oppose to a martial "thanatocracy" a neo-Lucretian vision of a relational, "femininized" or venusian science (cf. *CB* 196-208). I would rather agree with Prigogine and Stengers that "we can no longer accept the old a priori distinction between scientific and ethical values. . . . The ideas of instability, of fluctuation . . . diffuse into the social sciences" (312).

[21]I borrow this agonistic vocabulary from Hayles' own conclusion: "At a time when resistance to mastery is so sophisticated that it cannot help but be perceived as masterful, chaos presents . . . a resistance that alleviates the fear of mastery" (*CB* 293).

[22]See Gleick's chapter on Feigenbaum (155-87). It seems that Feigenbaum's right to credit for discovering the "Feigenbaum universality" is not universally accepted. Hayles too mentions other challenges to Feigenbaum's preeminence (*CB* 158).

[23]*The Beauty of Fractals: Images of Complex Dynamical Systems* (New York: Springer-Verlag, 1986) 8.

different: "Every nonlinear process leads to branch points, to forks in the path at which the system may take one branch or another. Decisions are made whose consequences cannot be predicted, because each decision has the character of an amplification. The smallest differences are blown up and have far-reaching effects. Causality holds at every single instant, but it does not carry over a sequence of branchings. Sooner or later the initial knowledge of the system becomes irrelevant" (Peitgen and Richter 1-2). Surely here is a heuristic that writers of fiction have grasped for some time, and that properly may now be turned to account in the human sciences generally.

Just as the astonishing "chaos" of the Mandelbrot set is not the old demonic chaos, Feigenbaum's "universality" is not the old global universality—the pure homogeneity of an imperturbable solid, like a marble slab. Fractal totalities and chaotic systems are fluid, complex, open, and infinitely productive of constrained deviations. Chaos theory does not intimate or replicate hierarchical structures; it represents the overcoming of the hierarchical mode. Sensitively dependent on irrecoverable micro-conditions, macro-levels remain in relative and relational rather than hierarchical connection to micro-levels.

So I consider it premature to foreclose the trope of chaos for the uses of political resistance to totalizing systems. Chaos theory provides energized metaphors for fluid resistance, figures that dissolve totalizing systems. These metaphors are admittedly unstable, and may have very short half-lives. That is the risk one runs with any metaphor: at least with tropes of resistance, their instability inscribes chaos within their very figure. Here at the beginning of the nineties, in a political moment when totalitarian regimes—which a decade earlier were declared (by less-than-clairvoyant reactionary ideologues) to be impervious to reformation—are attempting to undergo radical restructuring as the result of the dissident commotions of clusters of resisting individuals, I think we should keep our analogical options open. In our own culture, progressive resistance to totalizing systems still needs all the metaphors as well as all the science it can get.□

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Eric White

SERRES' REVALUATION OF "CHAOS"

In her recent book *Chaos Bound*, Katherine Hayles suggests that two main emphases have emerged in the literary reception of the cluster of fields currently referred to as "chaos theory": the first has for its point of departure the concept of "stochastic self-organization" (in Hayles' phrase "something out of nothing"), while the second focuses not on the passage from chaos to order but, rather, on the "orderly disorder" of systems that when mapped onto phase space reveal the presence of a "strange attractor" (the "figure in the carpet").[1] Taking the writings of Michel Serres as exemplary in their working through of the implications of chaos theory, I'm going to speculate in what follows that reflection on this second motif becomes necessary as a corrective to a certain impasse that arises from an exclusive preoccupation with the first. That is, the development in Serres' thinking from *The Birth of Physics* (1977) and *The Parasite* (1980) to *Genesis* (1982) involves a shift, in effect, from stochastic self-organization as key theme in chaos theory to the irregular regularity and infinite but nevertheless self-similar variety of systems in which can be detected a strange attractor. Despite his intention in *Genesis* to "speak of the multiple without ever allowing [himself] the aid of a concept," there is in Serres' more recent highly figured discourse an implicit invocation of this paradoxical, counter-intuitive notion.[2]

"Stochastic self-organization" conventionally describes the unpredictable emergence of orderly systems from states of chaotic flux. If random fluctuations threaten the stability of a system, they may also provoke systemic transformation. Such is the view of chaos taken by Ilya Prigogine and Isabelle Stengers in their *Order Out of Chaos*, whose principal topic is

precisely the phenomenon of emergence. At a bifurcation point, an unstable dynamic system far from equilibrium may choose one path of development over another in a random manner. The choice of which path the system will follow is purely a matter of chance. A dynamic system that has been destabilized by its environment may leap to a new regime stochastically. A microscopic fluctuation occurring, as Prigogine and Stengers say, "at the 'right moment,'" can ensue in total systemic change. Minute inputs yield unpredictably large outputs: "arbitrarily small differences in initial conditions are amplified" with the result that "new dynamic states of matter may originate, states that reflect the interaction of a given system with its surroundings."[3] Proximity to chaos, to the unforeseen spontaneity of random fluctuation, thus provokes the emergence of radical novelty. The present does not necessarily derive in a predictable way from the past.

To the extent that any closed system will inevitably decline toward thermodynamic equilibrium, chaotic fluctuation can therefore be positively valorized as a prelude to renewal. Physical systems, living systems, cultural systems are all, in Prigoginian parlance, "dissipative structures" dependent upon a flow from outside for renewal. To the extent they conform to the temporality of causal predictability by remaining invulnerable to destabilizing intrusions from without, they can only disintegrate, according to the law of increasing entropy in a closed system. The chronological time of linear causality is the time of entropic dissolution. Alternatively, the time of stochastic emergence, a time of risk to be sure, is also the only time when the possibility exists of reversing the slide toward entropic homogeneity.

Prigogine and Stengers thus posit an opposition between the time of linear

[1]N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca: Cornell Univ. Press, 1990).

[2]Michel Serres, *Genèse* (Paris: Grasset, 1982) 18.

[3]Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos* (New York: Bantam Books, 1984) 174, 12.

determinism and the time of stochastic emergence: "Near a bifurcation, fluctuations or random events play an important role, while between bifurcations the deterministic aspects . . . predominate" (176). And what redeems the world, in this account, is precisely the possibility of unpredictable change, that moment when the mundane run of things is punctuated by a genuine event. Stochastic self-organization conveys a message of hope: the recognition in the natural sciences (which have traditionally credited the notion of a completely determined universe) that history is open and disclosive.

But despite their rejection of historical process as predictable linear unfolding, it is equally important for Prigogine and Stengers that the metamorphoses brought about by successive intervals of fluctuation nevertheless have a specific direction. As a system becomes chaotic, suffused with random perturbations and noise, it becomes capable, potentially at least, of producing novel *complexity*. For Prigogine and Stengers, it is crucial that change be in the direction of ever more intricate and comprehensive order. If stochastic self-organization from chaotic fluctuation ideally results in an increase in overall systemic complexity, if disorder produces ever more complex forms of order, then history can be understood as a succession of evolutionary leaps upward. Prigogine and Stengers in fact imagine a universe propelled toward increasingly complex and higher levels of organization the culmination of which is that moment when intelligence finally succeeds in commanding the future course of evolutionary development. Thus privileging a hierarchy of complexity in nature and, consequently, the attribution of a teleological emplotment to natural history, they reaffirm what Jean-François Lyotard calls in *The Postmodern Condition* the modern "metanarratives" of emancipation and progress.[4]

The Lucretian view of stochastically emergent form is cited by Prigogine and Stengers as a forerunner of their own understanding of historical process. Like them, in his *On the Nature of Things* Lucretius posits a view of the universe at odds with causal determinism and the chronological time of linear development. According to the Epicurean cosmology expounded by Lucretius, the universe itself is a

vast occasion of evolutionary innovation, a chance conjunction of circumstances, in fact, a turbulent chaos of atoms in collision from which material form and human culture are unpredictably emergent.

The universe might thus be said always to be in the middle of itself, in the middle of a specific set of circumstances. There is no global reference point or controlling influence, only the locality of the present. The universe has no origin (because it always has existed), and no goal or final state (since it always will exist), and it can neither become an object of knowledge in its totality (for it is spatially infinite) nor be resolved into its constituent parts (since the atoms, the ultimate building blocks of reality, are themselves invisible). Thus, a transtemporal, asituational point of reference can neither be discovered from the beginning nor from the end, neither from "above," so to speak, nor from "below." At every moment, the universe is an incalculable convergence of forces no one of which can be assigned preeminence.

Causal determinism, predictable regularity, the end that resides in the beginning, the order of the same exists for Lucretius only to be undone. The eternal fall of the atoms through space is periodically interrupted, Lucretius says, by a minute aleatory swerving, the *clinamen*, a microscopic chance departure from linear flow that ensues in collisions among the atoms and the eventual emergence of form. Such an accidental swerve is truly an event, for here the repetition of the same is interrupted by the stochastic emergence of the unprecedented.

For Lucretius, the aleatory swerving of the *clinamen* is a promise of freedom. By swerving stochastically and unpredictably, the atoms "break the decrees of fate, that cause may not follow cause from infinity." And this applies not only at the level of physical particles but in human affairs as well, since "what keeps the mind itself from having necessity within it in all [its] actions . . . is the minute swerving of the [atoms] at no fixed place and at no fixed time."[5]

But the aleatory character of the atomic swerving does not mean that there are no constraints on the possibilities of evolutionary innovation. First of all, the perpetual renewal of the universe, the genesis of new form depends upon the disintegration of existing atomic

[4]Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: Univ. of Minnesota Press, 1984).

[5]Lucretius, *De rerum natura*, trans. W.H.D. Rouse, rev. Martin Ferguson Smith, 2nd ed. (Cambridge, Mass.: 1982) 115, 119.

compounds into their constituent atoms (Lucretius's version of the principle of entropy). Secondly, and here Lucretius diverges crucially from Prigogine and Stengers' ultimately utopian cosmology, if the number of atoms is limitless, the number of *kinds* of atoms is indeterminately finite, with the result that "a certain limit is set for things." Were this not so, "one thing more splendid than another would continually arise" (135). Lucretius would thus preclude any recuperation of Epicurean cosmology by the teleological narrative schemes of Universal History. Anticipating Nietzschean "eternal recurrence," or infinite transformation without progress toward a culminating state, he describes the universe as an unpredictably open occasion of metamorphic change that varies eternally yet always remains itself.

Serres explores the implications of this Epicurean cosmology in his *The Birth of Physics*. For Serres, the aleatory swerving of the Lucretian *clinamen* implies an unpredictably open universe in which knowledge will always be limited to strictly local circumstances, becoming, to borrow a metaphor from Hayles, a matter of "touch" (one brushes up against the world) rather than totalizing vision. History is a river of contingencies, a succession of chance convergences of heterogeneous forces whose perpetual metamorphosis can never become the object of global understanding. There is no common frame of reference, no "universal time," for "each thing has its own time. Atomism is . . . a temporal polymorphism."[6] And if there is no universal time, there is also, properly speaking, no "universe," so that a new way to imagine reality according to this "logic of multiplicities" would be as an archipelago in which stochastically emergent islands of realized form are surrounded by an inchoate sea of possibility.

Serres draws the Epicurean moral of the story: the "wisdom of the Garden," an ethic of the local, entails reducing "to a minimum the network of relations in which you are submerged." Live by the sea: "in the closest proximity to the angle of opening where the bifurcation is minimal, close to the clinamen, where Nature is born" (*Naissance* 164, 226). Live midway, in other words, between chaotic fluidity and inflexible order. Following Lucretius, Serres here opposes "Venus," goddess

born from the sea and thus the tutelary deity of stochastic self-organization, to "Mars," the god of deterministic trajectories. Serres imagines that Venus will overthrow Martial regimes of totalizing control, whether that be the chimera of absolute knowledge or the omnipotent state, by opening them to chaotic fluctuation, to perturbations enabling metamorphic rejuvenation of what would otherwise be doomed to entropic decay.

But Serres' formulation arrives here at an impasse. In this scheme chaos achieves its emancipatory aim through the production of new forms of order. Chaos is positively valorized, in fact, only in so far as it can be understood as a prelude to order. Chaos is a condition of formlessness and flux that serves as the generative space within which order can emerge. "Venus" stands not for chaos itself but for newly emergent order. She is not herself the flux of becoming: "What you see from the top of the cliff," Serres says, "is the first-born being arising out of the waters, Aphrodite, who has just been born in the swirl of liquid spirals" (*Naissance* 139).

The difference between Venus and Mars, it turns out, is not qualitative but only quantitative. The Garden of Epicurus and a military parade ground are both organized spaces, differing only in the degree of organizational rigidity: Venus is always about to become Mars. The emergence of order from chaos is therefore an endless task because the chaotic disruption of one claustrophobically closed system leads merely to another such regime. Lucretian science, an "organon of miracles, a discourse of the miraculous," affords no permanent protection, finally, from Martial regimes of totalizing power (*Naissance* 98). The emancipatory project must constantly be renewed.

Serres indicates his awareness of the dilemma in his next book. Unable to maintain the distinction between Mars and Venus, Serres now resorts to an ambiguous term, precisely, *The Parasite*.[7] On the one hand, the parasite renews decaying systems, overcomes stultifying redundancy and repetition, through the stochastic injection of novelty. But on the other, parasites preside over the systems they bring into being. The parasite is both the noise or static whose integration may yield an increase in

[6]Michel Serres, *La naissance de la physique dans le texte de Lucrèce* (Paris: Minuit, 1977) 169.

[7]Michel Serres, *The Parasite*, trans. Lawrence R. Schehr (Baltimore: Johns Hopkins Univ. Press, 1982).

information and the more familiar biological or social parasite who takes but does not give. Successive parasitic interventions merely result in the creation of what Serres calls "a parasitic chain" in which higher levels parasitically divert energy flows from below to their own purposes, a process that continues until the mounting din from this ramifying network of parasites becomes indistinguishable from white noise, or primordial chaos.

In the end, it is this latter aspect of the parasite that Serres considers predominant. The emancipatory innovations enabled by parasitic intrusions into closed systems are only temporarily liberating and inevitably succumb to the drive for control. The parasite, whose perturbation of a closed system ensues in systemic reorganization and an increase in complexity, is, finally, a formula for transcendence to a beyond that is merely a return of the same.

The problem here is that Serres' recourse to the model of stochastic self-organization does not escape what in *Genesis* he calls the "dualistic hell" of organizing one's understanding of the world in terms of binary oppositions: "we turn ourselves away from the waves in order to admire the one born of the waves," thus ratifying order and chaos as dichotomous terms (210, 58). Maria Assad has pointed out that Serres' recognition that Venus, goddess of stochastic emergence, has all along been an avatar of Mars, lord of closed systems, provokes a reconceptualization of Venus in *Genesis*. Instead of a coherent, finalized form, the task now is "to imagine turbulent Venus above the sea of noise," who resides, in Assad's words, "where ordered singularity and chaotic background noise cannot be separated." In other words, rather than imagining a passage from order to chaos or the emergence of new systems, Serres seeks to inhabit the space of chaos itself. *Genesis* thus marks what Assad describes as "a bifurcation in Serres' entire work." In his writings up through *The Parasite*, Serres has for his principal point of departure the phenomenon of emergence: "The dominant allegorical figures . . . privilege the attention given to the appearance of order out of disorder." But from *Genesis* on, Serres will explore the liminal zone where order and chaos are co-present: instead of the passage from order to chaos, the focus will henceforth be on "chaos at the core of order and order within chaos."[8]

In this revaluation of chaos, chaos is no longer

to be understood as the disorder that is antithetical and preliminary to order. "Chaos" is an undecidable commingling of order and disorder, both predictably periodic and unpredictably variable, a system whose stochastic fluctuations are literally infinite, in Serres' words, "a multiplicity of local unities and pure multiplicities . . . a chaotic multiplicity of ordered or unitary multiplicities and chaotic multiplicities" (*Genèse* 178). Seeking, as he puts it, an invariant or principle of constancy in the heart of instability, Serres looks to the phenomenon of turbulence as a median state between disorder and order. Turbulence moves "from randomness to a certain unity," while yet remaining within "the time that is productive of novelties" (*Genèse* 194). Turbulent Venus, "la belle noiseuse," occupies an anomalous middle space: both noise, or the information-producing potential of chaos, and beauty, or formal unity as opposed to the sublime alterity of what Serres calls the "pure multiple."

Serres had, of course, explored the metaphoric potential of turbulence before. In "The Origin of Language: Biology, Information Theory, and Thermodynamics," Serres characterizes an organism as a dissipative structure that maintains its quasi-stable shape by drawing upon an energy flow from outside itself, an "eddy closed upon itself for an instant, which finds its balance in the middle of the current and appears to move upstream, but is in fact undone by the flow and re-formed elsewhere."[9] And in *The Birth of Physics*, he remarks that "a whirlpool, both stable and unstable, fluctuating and in equilibrium, is order and disorder at the same time" (40). Moreover, he seeks in this text to avoid substantializing Venus as a finalized form when he observes that she "is not transcendent, like the other gods. She is immanent in this world, the being of the relation. She is identical with the relation" (153).

Yet notwithstanding these efforts to think a "middle" between order and chaos, Venus remains inflected, finally, on the side of order, albeit order newly emergent and open to

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[8]Maria Assad, "Michel Serres: In Search of a Tropography," in *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles (Chicago: Univ. of Chicago Press, forthcoming).

[9]Michel Serres, *Hermes: Literature, Science, Philosophy*, eds. Josué V. Harari and David F. Bell (Baltimore: Johns Hopkins Univ. Press, 1982) 75.

renewed chaotic fluctuation. Only with the deliberately paradoxical tropes of *Genesis* does Serres find a way out of the impasse. In *Genesis*, as Assad has observed, the text itself begins to fluctuate in chaotic fashion. For instance, from the moment "la belle noiseuse" threatens to become the master trope, the fixed point orienting the entire work, Serres displaces this figure with a new metaphor, "la belle danseuse." "La belle noiseuse" now stands for a space so saturated with possibilities as to be indistinguishable from primordial noise, the "roar of the deep," and must therefore make way for the "belle danseuse," the "body without qualities" that is free of dissonant singularities, in other words, the redemptive prospect of musical form.

Even with a strategy of chaotic troping such as this, dualistic thinking is not so easily overcome. Serres persists in gendering the new cultural space in a manner familiar to readers of Alice Jardine's *Gynesis*. Although he suggests at one point that the portrait of "la belle noiseuse" in the Balzac short story of the same name is the "complete chain of the metamorphoses of the sea god Proteus, it is Proteus himself," a gesture evidently intended to unsettle a binary gender metaphorics, in *Genesis* as in many other texts that have sought to think beyond the legitimating "grand narratives" of European culture there is what Jardine describes as "the valorization of the feminine, woman, and her obligatory, that is historical connotations," a move that reinscribes even as it ostensibly reverses a perennial tradition of dualistic thought (*Genèse* 41).[10]

Despite this qualification, in *Genesis* Serres does manage to "think a new object, multiple in space and mobile in time, unstable and fluctuating like a flame . . ." (152). There are for Serres two extremes of dystopia: on the one hand, the foundational noise or "roar of the deep" as threat of universal dissolution—"Noise, intermittence and turbulence, quarrel and uproar, this marine noise is the original din, it is the original hatred"—and on the other, the stabilized installation of an order that would be invulnerable to chance perturbations because "parasitic growth has immobilized everything" (33, 157). To evade these two perils, Serres proposes a self-organizing system whose coherence is secured through a certain

redundancy, a system that "echoes" itself, as he puts it, but one nevertheless able to generate new information through its incessant fractal agitation, a sort of energetic steady-state whose behavior is both infinitely various and deeply recurrent or self-similar, precisely, the tropical equivalent of the paradoxical concept of the *strange attractor*, a strange attractor whose infinite orbits within phase space nevertheless trace a recognizable shape, like the locally unstable but globally stable form of the famous Lorenz Butterfly.

I'm going to close with the suggestion that the development in Serres' thinking from the 1970s through early 1980s parallels that of co-authors Gilles Deleuze and Felix Guattari. In their *Anti-Oedipus* (1972), Deleuze and Guattari posit a dichotomy between the chaotic spontaneity of the "schizophrenic" and the despotic orderliness of the "paranoiac," affirming, utopianically, the former to the exclusion of the latter.[11] But in *A Thousand Plateaus* (1980), if a paranoiac dystopia persists in the form of "arborescent" structures of petrified becoming, Deleuze and Guattari now issue a caution to the effect that a schizophrenic "line of flight" may lead merely to a "black hole." Despite their earlier endorsement of the Artaudian "body without organs," in *A Thousand Plateaus* they insist "you have to keep enough of the organism for it to reform each dawn."[12] They therefore posit an ultimately unnameable "middle" for which a variety of tropes are offered.

Thus, instead of randomized desiring intensities, they describe the paradoxical unity of a "rhizome," the unity, that is, of a "multiplicity that necessarily changes in nature as it expands its connections" (8). Again, they refer to swirling patterns of vortical coherence that vary in relation to the intensity of the flows infusing them from without, vortices rotating in what they call "smooth space," a space without an orienting grid or overarching structure against which the location of an object can be specified, a space in which every object is equally at the center. They imagine, in other words, something like turbulence in laminar

[11]Gilles Deleuze and Feliz Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*, trans. Robert Hurley, Mark Seem, and Helen R. Lane (New York: Viking Press, 1977).

[12]Gilles Deleuze and Felix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: Univ. of Minnesota Press, 1987) 160.

[10]Alice A. Jardine, *Gynesis: Configurations of Woman and Modernity* (Ithaca: Cornell Univ. Press, 1985) 25.

flow. Or again, like Serres, to counter primordial noise they have recourse to a musical metaphor: In the beginning was not the word, or the fixity of a concept, but the refrain or song, "like a rough sketch of a calming and stabilizing, calm and stable, center in the heart of chaos . . . it jumps from chaos to the beginnings of order in chaos and is in danger of breaking apart at any moment," an eddy of harmony threatened with dissolution in a sea of dissonance (311).

Indeed, the book itself represents an attempt to enact "multiplicity" in discourse. Deleuze and Guattari deploy an array of "plateaus" of semiotic intensity, provisional metaphoric condensations that are meant to facilitate the reader's own interpretive copiousness when they are put into variation in relation to heterogeneous circumstances. Deleuze and Guattari would thus achieve something like what Lyotard has in mind when he refers in *Peregrinations* to the "lightness of thoughts": "Thoughts are clouds. The periphery of thoughts is as immeasurable as the fractal lines of Benoit Mandelbrot. . . . Thoughts never stop changing their location one with the other. . . . One cloud casts its shadow on another, the shape of clouds varies with the angle from which they are approached."[13] To put it another way, they hope to render the activity of making

sense what Prigogine calls an "open system," open to chance perturbations that provoke continuous shapeshifting. In the absence of transituational norms prescribing in advance the trajectory of thought, discursive production would then resemble what Deleuze and Guattari describe in one image as a "streaming, spiralling, zigzagging, snaking, feverish line of variation," and in another as the nomadic "fugitive mobility" of a "permutating, stationary whirlwind" (*Plateaus* 499).

Serres, Deleuze and Guattari, and Lyotard as well thus converge on a new image of vitality. Neither the randomized flux of Deleuzian schizotopia, nor the antithetical oscillation of chaos and order, noise and information, they now affirm what all refer to as the unity of a multiplicity. The "strange attractor" as a model of fluid, circumstantial, or shapeshifting form, an image of locally unpredictable and in that sense, information producing, irregularly regular recurrence somewhere between linear determinism and pure disorder has thus emerged as a necessary complement to stochastic self-organization as emancipatory innovation in the literary reception of chaos theory.□

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[13]Jean-François Lyotard, *Peregrinations: Law, Form, Event* (New York: Columbia Univ. Press, 1988) 5.

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Stephen J. Weininger

AFTERWORD

Molly Anne Rothenberg's essay begins with a borrowed Bette Davis movie line. I'll emulate her appropriation of popular culture, as well as her critical eye for unexamined assumptions, by adopting the motto "You've come a long way, baby!"

The "baby" in this case is literature and science. Where it has in fact come from, and where the preceding essays suggest it might be going, is my topic. I should also add a few words about what literature and science is, but that will be easier to do after its transformations are described. Literature and science resembles the fundamental particles that are often its subjects, which we can only characterize by recording their motions.

In the last decade or so a number of writers have given us overviews of literature and science which trace its evolution as a distinct area of study and survey a number of its current trends.[1] Their efforts relieve me of the necessity of giving anything like a history of the subject. I will, however, discuss a few dramatic changes which have shaped the context in which the current essays came into being.

Until the last few decades, the major concern of those in the field was to chronicle the impact of science on literature, as part of a larger project aimed at documenting and understanding the influence of science on culture.[2] This project embodied a model of the relationship between the two in which, in the language of algebra, science was always the independent variable and culture the dependent one. It is often designated the "influence model," about which

I'll say more further on.

Traditional literature and science studies were almost uniformly characterized by a respectful stance toward science, manifested particularly in their attitude toward scientific writing. This was usually taken at face value and exempted from the kind of analysis, interpretation, and explication to which literary works were subjected. And indeed, what could or should a literary analyst do with works that were written in a language that by general assent was understood to be neutral, transparent, free of rhetoric or figuration?

Even a casual glance at this volume will make apparent the extent to which the world of literature and science has turned topsy-turvy. As various and even heterogeneous as the papers here are, the focus of a majority of them is on scientific language—its vocabulary, rhetoric, discursive practices, semiotic structures. This reversal of stance is most straightforwardly apparent in Valerie Greenberg's analysis of Planck, in which his conventional claims to consistency, congruity between description and reality, and freedom from anthropomorphisms are shown to be compromised by his own rhetoric.

Once scientific language has been found to be rhetorical, then it's perhaps no surprise to discover it to be figural as well. Greenberg has no trouble detecting metaphors in Planck, and for Katherine Hayles their examination is central to any attempt to understand the role of language in science. For her and others they are nodal arenas where "science" and "culture" mix promiscuously. Here again the once seemingly incongruous has become commonplace. The traditional view of the cognitive status of metaphor is captured by Stuart Peterfreund's

[1] Gillian Beer, "Translation or Transformation? The Relations of Literature and Science," *Notes and Records of the Royal Society of London* 44 (1990): 81-99; Stephen J. Weininger, "Introduction: The Evolution of Literature and Science as a Discipline," in *Literature and Science as Modes of Expression*, ed. Frederick Amrine (Dordrecht: Kluwer Academic Publishers, 1989) xii-xxiii; *University of Hartford Studies in Literature* 19 (1987): 1-59 is devoted entirely to literature and science and contains articles by G. S. Rousseau, Stuart Peterfreund, E. S. Shaffer, and John Neubauer.

[2] Even a casual glance through *The Relations of Literature and Science: An Annotated Bibliography of Scholarship, 1880-1980*, ed. Walter Schatzberg, Ronald A. Waite, and Jonathan K. Johnson (New York: Modern Language Association, 1987) will give a clear sense of the intent of these studies.

observation that it was ". . . not a figure employed by those aspiring to empowerment through the attainment of knowledge." It now seems that even in science, metaphor precedes (and perhaps obliterates) metonymy.

The analytical scalpel wielded in these essays has also exposed for our skeptical scrutiny a long string of dualisms which are the staples of scientific (and popular) discourse: man/nature, reality/representation, observer/observed, natural/constructed, ordered/chaotic, determined/random, literal/figurative, cause/effect. Indeed, exposing the ideological commitments of these pairs of mutually supporting opposites has provided us a view of science very different from the official one, a view in which its social and cultural filiations are brought sharply into relief.

Thus, Hayles and Sharon Stockton each make clear the profound implications for both science and literature of a collapse in the sharp distinction between perceiver and perceived, while Rothenberg shows how clinging to the dualism of natural vs. manufactured can make strange bedfellows of ecologists and exploiters. And beyond these ideologically-implicated scientific constructs are the very thought processes which the "scientific method" presupposes, no longer shielded by a cloak of axiomaticity.

Two hundred years ago Blake had already mounted a powerful attack on these modes of thought, as Peterfreund's thorough analysis reveals. Yet in spite of the indictments by Blake and others, the nineteenth century saw an enormous growth in the authority of science, propelled by its stunning material achievements. That authority continued to increase throughout the first half of our own century, until the detonation of the Bomb eradicated the innocence of not only the physicists but also a great many of their admirers in the bleachers. Now, two centuries after Blake, the form of his critique may sound a little archaic but the strictures themselves do not. Several of the current writers embrace those strictures by questioning binary thinking itself, by casting doubt on the Aristotelian *tertium non quid* at the heart of science. As Mergler and Schleifer show, the ascendancy of binarity is itself a historically contingent process.

What we have in sum is a wide-ranging investigation of scientific language and thought at several levels. It aims, *inter alia*, to comprehend how scientific meaning is generated and to situate that activity within broader social and cultural contexts. Needless to say, this volume does not stand alone; it is just one tributary to a torrent of inquiries which are eroding the edifice of classical scientific realism. As this torrent washes away many venerable beliefs about the nature of science, it also sweeps along some cherished models of scientific inquiry. So it would be appropriate to ask what contributions literature and science is making to new visions of the scientific enterprise.

It's my own belief that contemporary literature and science studies have played a particularly valuable role by emphasizing the extent to which scientific activity is bound to texts, and more generally to peer-constructed, historically fluid systems of representation. The papers of Greenberg and Hayles in this collection clearly exemplify this trend.

Reading Hayles' piece reactivates the amazement I still feel at the rapidity with which constructivist accounts of science have become not only plausible but respectable. When I am away from the bench, and reflect on what goes on there, I am also persuaded of the validity of this approach to comprehending how science works. In common with many of my colleagues, I often play around with symbols and formulas in an atmosphere of great (although not limitless) freedom well before I set foot in the lab. And then there is that uncanny feeling that one gets when one's colleagues repeatedly overcome "natural" barriers while always adhering to the rules of the game. It mixes admiration for their accomplishment with some puzzlement at how the barriers got there in the first place.

The constructivist scenario has probably had its greatest impact on our perception of scientific authority. The conviction that science is socially constructed brings with it the realization that scientific authority is constructed as well. Peterfreund and Rothenberg describe struggles for the possession of that authority, while Michele Birnbaum's paper demonstrates that scientific authority, once attained and naturalized, is a very powerful social and political tool. In the chilling tale which Birnbaum recounts, the tool is employed for repugnant ends, but that is certainly not an inevitable outcome. Eric White shows Michel Serres' ongoing engagement with chaos theory as a struggle to enlist it in support of a vision of political and cultural renewal and eventual, if partial, freedom from deterministic, totalizing

systems, a prominent theme in Bruce Clarke's paper as well. Even constructivized science can be a powerful ally.

The illumination which constructivism has brought to issues of scientific authority is not yet matched, in my opinion, by corresponding powerful insights into the nature of scientific *efficacy*. Surely a good measure of science's power derives from its doing what it says it can and will do. When I remarked earlier that constructivist accounts of science were rapidly becoming respectable, I should have added, "among philosophers, historians, sociologists, literary theorists,"and so on. Their popularity among scientists is growing much more slowly. In order to see why, let me again draw on my own experience.

I have been active in literature and science for nearly a decade and work on the history of science as well, both of which draw on my long-standing interdisciplinary interests. Yet when I am in the lab I am as much a realist as any of my co-workers. My friend Evelyn Fox Keller, who has also worked both sides of the street, thinks that it may not be possible to work in the lab and be anything but a realist. This is not an argument for realism; it partakes more of the point of view embodied in the famous wartime quip that there are no atheists in foxholes. At the least, it emphasizes the enormous power of the discursive practices with which virtually all scientists work.

To me, then, one of the major challenges confronting literature and science is to understand the interaction among texts, representations, and discursive and material practices in constituting a field or discipline. More specifically, we have to find out what makes science *different* from other pursuits. Literature and science, in concert with other interdisciplinary projects, has done a salutary job in demonstrating the similarities between science and other discourses, thus aiding the return of science to the fold of general culture. At the same time, we would have a hard time making a credible case that science is simply the *same* as other disciplines.

I can illustrate the problem by making use of Hayles' felicitous notion of science as "constrained constructivism." If we reflect on its premises then we have to concede that all discourses are somehow constrained, at the very least by our status as biological creatures. The question we then have to ask is, "Are the constraints that operate in science different from those in literature or sociology; are they what give science its distinct character?" If we answer yes, then would we want to say that science is subject to "external" constraints while literature, for instance, is only constrained "internally"? To do so would involve returning to the standard dichotomy of internal/external; my sense is that the writers represented here would be reluctant to do so, as would I. Yet we need to make distinctions if we are to further understanding.

Which suggests to me that another task for literature and science is the quest for meaningful distinctions within the potentially homogenizing discourse of constructivism. Apropos of that, let me return again to the issue of dualistic thinking. I earlier noted with approval how many of our commonplace dualisms had come under attack here. That said, I want to further add that I am reluctant to condemn dualistic thinking *tout court*. I rather adopt the position which the philosopher Richard Bernstein took in confronting the question of whether science is "objective" or "subjective." In brief, he said that (1) the question was undecidable; (2) undecidability did not, however, make it automatically uninteresting or fruitless; (3) in this particular case the debate had exhausted its usefulness. Given the deep embededness of binary dualisms in our culture's modes of thought, as Mergler and Schleifer make clear, I would endorse Bernstein's pragmatic attitude toward them. A corollary of that attitude is that no fixed set of categories will answer our needs at all times and in all cases; the enterprise is a fluid, historically contingent one.

That fluidity seems to me to characterize all of literature and science, making it very difficult to pin down what the field actually *is*. When Clarke explores the concepts of resistance across a side spectrum of disciplines he does so ". . . for the connections they make possible and the provisional amplifications they produce. . . . One entertains such analogues not as stable identities, but as experimental heuristic moves in an open dialogue." White refers to the ". . . liminal zone where order and chaos are co-present." This is the habitat of literature and science, among the interstices of academic life, calling into question the self-understanding of all the disciplines on which it borders, *literature included*. It is in fact a very tricky region in which to find one's footing; one who has is Primo Levi, whose *Periodic Table* is a supreme example of the balance that can be maintained between what I am constrained to call metaphor and reference.[3]

In musing on the changes which literature and science has undergone over a period of some decades I was struck also by what aspects of the relationship have changed but little. In the past, literature and science served as a conduit, conveying the latest scientific ideas to a literate but nonscientific readership. That function has not completely disappeared. Any reader who has come this far without realizing that chaos theory and information theory are "hot" topics has been inattentive indeed. And more than information transmittal is taking place.

When Clarke notes that ". . . the new scientific paradigms are making us more comfortable with unstable descriptions," it suggests to me that our models of how literature and science interact are dependent on, and perhaps even authorized by, our models of what science is. When science was conceived of as linear and deterministic, so was our notion of that interaction. The "influence model" was a *causal* model in which independent events in science brought about changes in literature. The operative word was "impact," which certainly conjures up the world of Newtonian (if not Aristotelian) physics.[4] Now that science (or at least some highly visible sectors of it) is relinquishing classical causality we too are abandoning it in favor of fluidity, turbulence, indeterminacy, and so on. In pointing this out I am not poking fun but rather encouraging self reflection. There certainly have been changes in literary theory which appear to be correlative to those in science. If we no longer accept influence as a viable explanation, what is to stand in its place? The theoretical work in our field is just beginning.□

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[3]Primo Levi, *The Periodic Table*, trans. Raymond Rosenthal (New York: Schocken Books, 1984).

[4]It is difficult to avoid the words "impact" and "influence" while thumbing through any part of Schatzberg, Waite, and Johnson.

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