

Contemporary American physics fiction^{a)}

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The great post-Newtonian revolution in physical science culminated with Einstein's general theory of relativity in the second decade of our century, and with the establishment of the quantum theory in the third decade. The responses of literature over the past half century to these changes in world view have served as stimulating examples of cultural interchange. The novels of Thomas Pynchon, William Gaddis, Robert Coover, Joseph McElroy, Don DeLillo, and Robert Pirsig make use of the new physics as metaphor for three traditional activities of novelists: examining order and disorder, questioning cause and effect, and seeking unity in the human and physical universes.

INTRODUCTION

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Science and the literature of the humanities display at least three kinds of interaction. The first is direct exposition: using science to explain or expand the processes of the arts, or using the arts to provide cultural impact statements on the results of science and technology. Science fiction, from H. G. Wells to Stanislaw Lem, has traditionally provided cultural impact statements for technological changes. A second, less technical use of science is as a source of metaphorical inspiration—using models, images, and language from science to discuss an aspect of the human condition that the author perceives to have similarities to a topic in the physical universe. Lawrence Durrell's use of physical relativity as a structure for *The Alexandria Quartet*, concerned with the relativity of human truths, is perhaps the best known and most controversial example of this kind.² The American "physics fiction" of the past decade that I discuss below generally falls in this group and would be considered by physicists as truer to the source of the metaphor than Durrell's work. Experiments in physics fiction must be judged, however, by more than the accuracy of their physics.

A third possibility is to approach the similarities between science and the arts directly. Why were both science and the arts redefining time at the turn of the century? In the first years of our century, Einstein was developing new theories of time and space, and Joseph Conrad was writing a novel, *The Secret Agent*, with "holes in space and time"³ as stylistic elements. It could not be simply the scientists influencing humanists, or vice versa. Recent criticism, for example Ihab Hassan's *Paracriticisms*,⁴ has established such parallels or even convergences occurring in postmodern culture.

The novels of Thomas Pynchon, William Gaddis, Robert Coover, Joseph McElroy, Don DeLillo, and Robert Pirsig make use of physics principally as metaphor and symbol of

three activities: examining order and disorder, questioning cause and effect, and seeking unity in the human and physical universe.

EXAMINING ORDER AND DISORDER

Novels that concern order and disorder comprise much of the fiction that uses physics. How do we cope in a world confused by chaos? This theme, like the others I will discuss, is certainly not a recent invention. But the theme of order versus disorder, as presented in Pynchon's⁵ *The Crying of Lot 49* and *Gravity's Rainbow*,⁶ and Gaddis' ⁷ *JR*, is closely related to twentieth-century interpretations of the second law of thermodynamics.

This theory states that all physical interactions tend toward increasing disorder in the universe. Disorder is defined statistically, and called entropy. While the second law applies most obviously to chemical reactions or to the behavior of big collections of simple elements (like atoms in a box), we have learned in this century to use the law in surprising new areas. Norbert Wiener capped several decades of work by showing how to discuss information and noise mathematically using the second law, and how to use these mathematics to expand our understanding of everything from computers to human language and the processes of biology.⁸

The use of this theory as metaphor is explicit in three of Pynchon's works, "Entropy,"⁹ *The Crying of Lot 49*, and *Gravity's Rainbow*. Each includes references to Wiener's nontechnical essays on the human significance of the second law of thermodynamics, and each has been discussed in detail in several critical essays.¹⁰ These essays agree that Pynchon makes real the physicists' own metaphors, such as James Clerk Maxwell's "Demon," as well as arcane bits of history and subjects from other academic disciplines. He uses them with such craft that many readers accept the entire body of metaphors as Pynchon's original creation. The discovery that half of the fantastic imagery in his fiction is solidly rooted in reality might well push the reader toward disorientation and a taste of the paranoia that Pynchon's characters themselves suffer.

The physicists' work with the second law has helped us accept, in the physical world, the inevitability of disorder. Disorder is a necessary adjunct to the creation of new order. Pynchon's characters are distressed by disorder at every turn, but they also witness the marvelous fertility that exists

amidst the chaos. The roof top of Pirate Prentice's London apartment in *Gravity's Rainbow* is a garbage heap, but it is also capable of nurturing the most unlikely plants—even bananas.¹¹

Thermodynamics also serves as an apt metaphor in Gaddis' *JR*. *JR* is not as enthusiastically didactic about physics as is *The Crying of Lot 49* or "Entropy," but it does contain a reference to Wiener that summarizes the entire novel: "Whole God damned problem . . . whole God damned problem listen whole God damned problem read Wiener on communication, more complicated the message more God damned chance for errors, take a few years of marriage such a God damned complex of messages going both ways can't get a God damned thing across, God damned much entropy going on . . ." ¹²

The speaker is Jack Gibbs, who is composing a novel from scattered notes including bits of Hemingway and *Physical Review Letters*, and lives in an apartment that resembles the rooftop compost garden in *Gravity's Rainbow*. Gibbs' speech follows Wiener's dictum that repetition is the way to get a message across in a high noise environment. There is a lot of repetition in this 726-page novel.

Josiah Willard Gibbs was an American physicist, one of the first to realize the far-reaching applications of the second law of thermodynamics. This historical Gibbs took the thermodynamics discovered for steam engines and showed that the theory could be used to discuss interactions in general. This set the stage for later work using the second law for communication theory and the thermodynamics of life itself. In *JR*, a friend of Jack Gibbs is an inventor working on problems of the steam engine and the problems of retaining biological order while trying to transport people over a telegraph wire.¹³ Even if these delightful coincidences in names and interests were unplanned, *JR* illustrates Wiener's themes quite well. American society seems to get along in Gaddis' novel despite the massive infusions of noise and meaningless data that fill our world and the novel.

Physics itself tells us nothing about the consequences for society of our concern with order and disorder. The second law of thermodynamics insists that increasing disorder in the universe is the price for the flow of energy and life, but our planet is a small section of the universe, and how we arrange our order-disorder mix depends on much more than physical laws. But the fictions of Pynchon and Gaddis are compelling demonstrations of one particular conclusion consistent with physics: disorder and life always go together.

QUESTIONING CAUSE AND EFFECT

One way to get around our frustration with essential disorder is to imagine that cause and effect operate everywhere, and hence disorder is only unrecognized order. Complete reliance on this way out could lead in human terms to paranoia, the specter always looming in Pynchon's novels. Concern for hidden, secret order in seemingly random events is also ominously present in Coover's *Universal Baseball Association, Inc. J. Henry Waugh, Prop.*¹⁴ and McElroy's *Lookout Cartridge*.¹⁵ In physics, the second law of thermodynamics treats statistically defined disorder in large assemblies, and says nothing about the existence of cause and effect in individual cases. The most revolutionary idea in 20th century physics, quantum theory, introduced the concept of *essential* randomness.

One interpretation of the quantum theory, the Heisenberg Uncertainty Principle, states in part the more that one knows of the speed at which a particle is moving, the less one can find out of its location—and vice versa. This essential uncertainty has been repulsive to the moral temperaments of many physicists, including Einstein, who protested that "God does not play dice with the Universe."¹⁶

Coover's *Universal Baseball Association* presents J. Henry Waugh, a god who does play dice with his universe. The subcharacters Waugh creates speculate, as we do, whether life and death are random or the result of a hidden power. Henry, like Einstein's God, finds it too cruel simply to play dice, and breaks his own rules to interfere on the side of justice. Two critical papers have explored the fine, intricate analogy between Coover's novel and the philosophical debate over the quantum theory in physics, and readers are referred to those for further discussion.¹⁷ The *UBA*'s presentation of this metaphor, which supports the complete structure of the novel, is one of my favorite examples of the fruitful relationships possible between physics and fiction.

McElroy's *Lookout Cartridge* is a stream-of-consciousness detective story, and the mystery genre is a fine place to test causal relationships. Like a physicist, the narrator in *Lookout Cartridge* tries to find an underlying reality beneath the noise, error, and randomness around him. The pursuit of order is elucidated by numerous individual metaphors on the images of order and disorder in physics. George Stade compares the density of these metaphors to Pynchon's: "It is like Pynchon's *Gravity's Rainbow* in that its symbolic and allusive formulae come from science and technology rather than from literature and other art, and in that one reads through it as one might move through sets designed by a secretive and paranoid demurge."¹⁸

Pynchon's *Gravity's Rainbow* uses crystals as a repeated image of order in the physical universe. McElroy's novel introduces liquid crystals as one of its most effective repeated metaphors: "But while Whitehead went on to retail me as if I did not know then the practical applications and fun things a boy could do with liquid crystals like testing the warmth of your fingerprint by the colors that emerged on the encapsulating plastic sheet, it was plain that Whitehead . . . had no feel for the real inner properties of liquid crystals: structure of a solid but mobility of a liquid, structure ordered clearly yet not rigid in the normal course of three dimensions, molecules bonded like a liquid's, other properties complex and marketable."¹⁹ Like a liquid crystal, order in the human universe of *Lookout Cartridge* is fundamentally partial, and cannot be pinned down. In analogy to the Heisenberg Uncertainty Principle, the more precisely the narrator defines one aspect of his universe, the greater his uncertainty about a conjugate aspect. Although there are frequent, accurate similes to physics, anthropology, and other sciences in *Lookout Cartridge*, no dynamic image from science structures the novel, as the image of Einstein's God may be said to structure the *Universal Baseball Association*.

SEEKING UNITY IN HUMAN AND PHYSICAL UNIVERSES

As final examples of physics fiction, consider novels which tackle the relationship between science and the

human universe directly. In these cases, science becomes an explicit subject of the novel, rather than an implicit parallel. Such is the case in DeLillo's *Ratner's Star*,²⁰ Pirsig's *Zen and the Art of Motorcycle Maintenance*,²¹ and McElroy's *Plus*.²²

Ratner's Star presents quantities of science, although much of it is exaggerated or distorted so that, as in Pynchon's fiction, it is hard to tell the fabulation from the physics. The parodies of scientists who inhabit Field Experiment No. 1 are more central than the science they do, however. They are mixtures of two abstract conceptions of scientists: the freakish human eccentrics of popular culture, and the impersonal logical machines that seem to write the papers in staid journals of science. Scientific journals suppress the subjective aspects of the creative process, and many scientists believe that science is in fact a basically impersonal process of discovery. This has led to a current debate about the creative process in science, with historians of science like Jacob Bronowski,²³ Gerald Holton,²⁴ Arthur Koestler,²⁵ and Thomas Kuhn²⁶ finding it necessary to argue that the progress of science is governed by the human universe as well as the physical one.

Billy Twillig, the 14-year-old protagonist of *Ratner's Star*, works in purest mathematics that he thinks have no contact with the real world. A fiction writer in the novel describes her work in similar terms: "I plan to make strict rules that I plan to follow. Reading my book will be a game with specific rules that have to be learned. I'm free to make whatever rules I want so long as there's an inner firmness and cohesion, right? Just like mathematics, excuse the comparison."²⁷ But the scientist's ideas do keep touching both the physical and human universes, and suffering often results. *Ratner's Star* ends as an eclipse of the sun and of reason begins, literally around the world from the fantastic Field Experiment No. 1. The reader glimpses there the desperately poor and hungry, and parody gives way to pathos. The scientists come to the end of their search and find, as T. S. Eliot predicted, that the end of all their searching is to come back to their origins and see them clearly. With *that* sight madness envelops all, even Billy Twillig. The failure to resolve the relationship between the abstractions of science and human problems is devastating.

Pirsig's *Zen and the Art of Motorcycle Maintenance* and McElroy's *Plus* have remarkable similarities in their approach to this same theme. Both have a protagonist who is trying to reconstruct his former personality. The narrator of *Zen* was driven insane by his attempts to reunite the classical and romantic aspects of reality, and a new personality created after shock treatment has set out to discover his past. The narrator of *Plus* has literally suffered from dissociation of brain and body. After a fatal exposure to radiation, a scientist allows his brain to be used in an experiment, and that disembodied brain tries to reconstruct its previous life.

The narrator of *Zen* presents his search for underlying unity in a series of lectures on the relations between science, technology, and the humanities. He calls the unity "Quality," and strives to recall the efforts of his former personality, called Phaedrus, to understand the term and thus resolve the two culture gaps: "What brought tears of recognition to my eyes was the discovery that these unfinished edges match perfectly in a kind of harmony that both Phaedrus and Poincaré talked about, to produce a complete structure of thought capable of uniting the separate lan-

guages of Science and Art into one."²⁸ These lectures recreate much of the controversial discussion mentioned about human and nonrational elements that contribute to creativity in science. *Zen* exemplifies the intuitive process of creation in its descriptions of motorcycle maintenance, but also with many specific examples from theoretical science. Many of these examples are not accurately presented and facts from science in Columbus' time to Einstein's are unreliable (Pirsig disclaims accuracy on motorcycles and *Zen* in an author's note). Despite the problems of detail, the difficulties in resolving dualism between science and the humanities are presented in the form of a compelling human dilemma.

The narration of *Plus* is from the sole viewpoint of the human brain orbiting the earth in a satellite. The brain slowly pieces together what has happened to it, and develops a strange new personality, part human, part logical machine, and part wondrous new being linked to the sun and the universe. The author helps the brain narrate this process by supplying words the brain has forgotten, and the brain invents new words for parts of itself that are being created: "sunbraids" and "webfolds." This grotesque situation has an immense human sadness as the brain remembers bits of emotion, fragments of time on a beach, on a street, in a room. The alien that develops can only be described in technical and undefined words, yet it too is somehow sympathetic.

The remarkable achievement of *Plus* is that we care about the fate of this strange being, hardly within our own ken. Somewhere around the molecules and electric currents that represent the best description science can give us, there is an elementary life we sense but do not visualize. The superhuman search for a unitary personality in *Plus* is similar to the human search of *Zen*. In both cases we are convinced that something important exists presently beyond the vision of our physical or human universe.

CONCLUSION

I have selected examples of physics fiction in which images from science enrich the themes of the novels. These examples have ranged from the fluent and frequent inclusion of casual metaphors, as in *Lookout Cartridge*, to the elaborate system of physics metaphors in Pynchon's work. Does it help us to appreciate the novel if we understand the use of science? In Pynchon's case, so much of the language and imagery of the novel comes from physics that readers who are unfamiliar with modern science find many sections as opaque as if written in an unknown language. A knowledge of the roots of the images transforms these sections from fantastic abstract designs to recognizable, important parts of our world. Coover's *Universal Baseball Association*, on the other hand, presents fundamental problems in the interpretation of physics entirely without the direct language of physics, and the reader is never compelled to recognize the potential relations between the physics and the fiction.

The necessity of recognizing physics metaphors in the other novels I have discussed lies between the extremes of Pynchon and Coover. The images are explicit in these other works, but not so all pervasive that they force the reader to deal with them. Understanding them adds to the connections the novels make in the reader's own conception of the human condition.

As one whose profession is science, I am certainly biased toward thinking an awareness of science is essential, and that science can inform our search for ways to understand our human problems. Science, after all, is one human endeavor that has had some success in doing what it set out to do. We wanted to understand the shape of the physical cosmos, and through science we have learned more about that shape than we knew 300, 75, or even one year ago. Of course, science limits itself to a very narrow range of questions; of course, scientists have strikingly little to be proud of in their abilities to forecast or control the uses of the understanding of the cosmos that society will make.

Although the quality of these interactions of physics with recent American fiction varies widely, I reach three positive conclusions about these examples. (i) With the exception of DeLillo's *Ratner's Star*, these novels are not anguished confrontations with the impositions of science. That was how literature initially responded to the shocks of the Copernican and Darwinian revolutions. Today we can see physics selected energetically as a tool for the purpose of making fiction. (ii) The most effective of these interactions of physics with fiction, in the works of Pynchon and Coover, have physics serving as metaphor. The more direct symbolism in the novels of DeLillo and Pirsig can become obtrusive. If some of the physics is inaccurate, as in *Zen and the Art of Motorcycle Maintenance*, the reader is likely to be confused rather than rewarded for his attempts to understand the specific symbolic functions. (iii) As physics may be useful in understanding the work of many young writers, we should look more closely to the fundamental question of the role of science in the humanities. That similar subjects are of intense renewed interest to both science and literature affirms an underlying compatibility in the work of the humans who perform those two similar acts of creation.²⁹

^aThe term "physics fiction" is borrowed from Vladimir Nabokov's *Ada* (McGraw-Hill, New York, 1969), p. 339.

¹An annual bibliography of criticism on literature and science is published in *Clio*; see also Marjorie Nicolson, *Am. J. Phys.* **33**, 175 (1965).

²For Durrell's ideas on the usefulness of physics for literature, see his chapter "Space Time and Poetry," in *A Key to Modern British Poetry* (University of Oklahoma, Norman, 1970), pp. 24-48 and his introduction to *Balthazar* (Dutton, New York, 1958). For criticism of

Durrell's physics metaphor in *The Alexandria Quartet* see Alfred M. Bork, *Centennial Rev.* **7**, 24 (1963), which looks at the uses of physics itself. There is a large body of Durrell criticism on the effectiveness of the metaphor. See John A. Weigel, *Lawrence Durrell* (Dutton, New York, 1966), pp. 81-96.

³Joseph Conrad, *The Secret Agent* (Doubleday Anchor, New York, 1953), p. 80 (original publication 1907). I am indebted to Professor Michael Gregory at San Francisco State University for pointing out Conrad's experiments and use of this phrase.

⁴Ihab Hassan, *Paracriticisms* (University of Illinois, Urbana, 1975).

⁵Thomas Pynchon, *The Crying of Lot 49* (Lippincott, Philadelphia, 1966).

⁶Thomas Pynchon, *Gravity's Rainbow* (Viking, New York, 1973).

⁷William Gaddis, *JR* (Knopf, New York, 1975).

⁸Norbert Wiener, *The Human Use of Human Beings* (Avon, New York, 1967) (original essay published 1954).

⁹Thomas Pynchon, *Kenyon Rev.* **22**, 277 (1960).

¹⁰See Bruce Hertzberg's bibliography, *Twent. Cen. Lit.* **21**, 221 (1975).

¹¹For a discussion of this image see Alan J. Friedman and Manfred Puetz, *Contemp. Lit.* **15**, 345 (1974).

¹²Reference 7, p. 403.

¹³Reference 7, p. 498.

¹⁴Robert Coover, *The Universal Baseball Association, Inc. J. Henry Waugh, Prop.* (Random House, New York, 1968).

¹⁵Joseph McElroy, *Lookout Cartridge* (Knopf, New York, 1974).

¹⁶For a review of the origin and many uses Einstein made of this phrase, see Ronald Clark, *Einstein: The Life and Times* (World, New York, 1971), pp. 340-345.

¹⁷See Alan J. Friedman, *Trema* **1**, 147 (1976); Arlen J. Hansen, *Novel* **10**, 49 (1976).

¹⁸George Stade, *NY Times Book Rev.* **3** (Feb. 1975).

¹⁹Reference 15, pp. 99-100.

²⁰Don DeLillo, *Ratner's Star* (Knopf, New York, 1976).

²¹Robert M. Pirsig, *Zen and the Art of Motorcycle Maintenance* (Morrow, New York, 1974).

²²Joseph McElroy, *Plus* (Knopf, New York, 1977).

²³This is the theme of essentially all of the essays collected in Jacob Bronowski, *A Sense of the Future* (MIT, Cambridge, MA, 1977).

²⁴Gerald Holton, *Thematic Origins of Scientific Thought: Kepler to Einstein* (Harvard University, Cambridge, MA, 1973).

²⁵Arthur Koestler, *The Act of Creation* (MacMillan, New York, 1964).

²⁶Thomas Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (University of Chicago, Chicago, 1970).

²⁷Reference 20, p. 352.

²⁸Reference 21, p. 263 in the Bantam edition.

²⁹This paper is a revised version of an oral presentation given at the Modern Language Association's meeting in Chicago, December 28, 1977.