THOMAS PYNCHON'S *GRAVITY'S RAINBOW*: QUANTUM MECHANICS AND POSTMODERN FICTION

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This work is for Donya and Dylan.

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Table of Contents

Abstract ....................................................... v-vi

Chapter 1: Thomas Pynchon: Modernism Transformed ............. 1-19

Chapter 2: Quantum Mechanics: Playing Dice With the Universe... 20-45

Chapter 3: Getting Hit by Lightning: Gravity's Rainbow ......... 46-76

Works Consulted ............................................. 77-86
ABSTRACT

THOMAS PYNCHON'S GRAVITY'S RAINBOW: QUANTUM MECHANICS AND POSTMODERN FICTION

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Postmodern American fiction differs from the Modernist tradition of Faulkner, Joyce, Woolf, and Fitzgerald in that it deals with "multiple realities." While Modernist writers questioned the reliability of a narrator's perceptions, an underlying reality such as Joyce's Dublin still existed to validate the reader's perceptions. With Postmodern fiction, however, this reality is gone, reflecting the fracturing of American experience into multiple realities, an observation supported by contemporary psychology and physics as well.

Thomas Pynchon is the paradigm of the contemporary fiction writer. His major work to date, Gravity's Rainbow, dealing with this idea of multiple realities, has become the subject of more critical writing than any novel since Joyce's Ulysses. However, Pynchon critics
still view this work as a Modernist text, interpreting his characters as failed questers, unable to reach any epiphany or revelation about the contemporary world.

Using the world of quantum mechanics as literary metaphor, Pynchon has adopted the idea of transformation, as found in particle physics, as his theme. Viewing his work through the traditional notions of Newtonian physics only leads to the conclusion that Pynchon's characters are doomed to failure in a pre-determined world ruled by the Second Law of Thermodynamics or entropy. However, when read as an expression of the quantum mechanics point of view, Pynchon's work presents a life-affirming message of the possibilities inherent in the idea of transformation.

This is most evident in Gravity's Rainbow. While most critics have given it a "doom and gloom" apocalyptic reading, a positive reading emerges when the novel is interpreted through the point of view of quantum mechanics. Tyrone Slothrop, the "failed" hero of the novel, becomes the embodiment, not of failed revelation, but of the quantum concept of transformation, especially at the end when he disintegrates into the very world of particle physics from which Pynchon derived his quantum metaphor.
If reality is somehow extra-causal, then a whole new vista of ideas is opened up -- a territory hitherto only colonized by intuition. If the result of every experiment, of every motion of nature, is completely unforeseen and unpredictable -- then everything is perpetually brand new, everything is, if you care to think of it like that, a miracle.

-- Lawrence Durrell,

*A Key to Modern British Poetry*
Suppose we suddenly wake up and see that what we thought to be this and that, ain't this and that at all?

-- Jack Kerouac

In his encyclopedic study, *American Fictions 1940-1980*, Frederick R. Karl identifies the difference between the Modernist tradition of Faulkner, Joyce, Woolf and Fitzgerald and the Postmodernism of contemporary American fiction as the idea of "multiple realities." While modernist texts such as *Ulysses*, *The Sound and the Fury*, and *The Great Gatsby* questioned the reliability of the self's perception of the world, there still existed an external reality, a collection of objective facts, that the reader knew to be there: Joyce's Dublin, Faulkner's South, Fitzgerald's East Coast. As Brian McHale points out in "Modernist Reading, Post-Modern Text," reliability and unreliability coexisted on different levels in the same work. While the reader could question the reliability of a character's observations, his primary job was to reconstruct those "elements of external (fictive) reality from the evidence of a character's mediating consciousness..."
(McHale 88). In *The Sound and the Fury*, for example, "reality" as filtered through the consciousness of Benjy, and then Quentin, is only further substantiated by the later observations of Jason and Dilsey. However, the reader educated in this modernist tradition will likely find himself frustrated with a postmodern text like Thomas Pynchon's *Gravity's Rainbow* where, according to McHale, "reconstructed realities are liable to be undermined by passages appearing literally hundreds of pages later in the book" (94).

This fracturing of reality has come about through a dividing up of the "American Dream" experience. Karl defines this dream as a conflict between the pastoral ideal of American as a lost Eden and the industrialized and urbanized reality of what America has become. This American dream, though no longer credible, is still pursued: "its paradoxes, ironies, misconceptions, irresolvable conflicts become the stock-in-trade of the post-war novelists" (Karl 16). The world of objective facts, the underlying reality of *The Sound and the Fury*, dissolves into a background of paradox, irony, and mutually exclusive realities. Yeats' perception in "The Second Coming" that "the centre cannot hold" (184) is a modernist image. However, in postmodernism, there is no center and therefore "the deconstructive impulse of post-modernist texts has little in common with the confident irony of modernism...the post-modern text resolves nothing, and denies self-sufficiency and autonomy" (Couturier 38). One perception about the nature of reality can be contradicted by or coexist with the next. In quantum mechanics, this relationship is called the theory of
complementarity -- Niels Bohr's explanation of the wave-particle duality of light. Faced with the existence of contradictory and mutually exclusive "realities," characters like Heller's Yossarian, Updike's Rabbit, and Pynchon's Tyrone Slothrop often choose to run away rather than face "realities."

The idea of multiple realities is the revolution of postmodern fiction. No longer can a reader apply traditional Newtonian logic about the nature of physical reality to the physical "realities" portrayed in contemporary fiction. With the advent of modernism, the reader could no longer function only as an observer; in postmodern fiction, the writer demands the reader participate in the creation or projection of a "world." There can no longer be any final authoritative intrusion undercutting the observations of the reader. In Robert Coover's "The Babysitter," there are over five hundred possible explanations of "what really happened," depending on the perceptions of the reader. In another of his short stories -- "Whatever Happened to Gloomy Gus of the Chicago Bears?"-- Coover best expresses this idea in fictional terms:

only for the egoist and the dogmatist...is there one "history" only. The rest of us suffer from the suspicion that there are as many different histories as there are people and maybe a few more -- out here in the flood, after all, what configurations can we not imagine? (34)

Another contemporary American writer, Donald Barthelme, feels that the idea of multiple realities arises out of the insatiability of the self. An
existence that is whole and full of meaning is a dream: "Endings are elusive, middles are nowhere to be found, but worst of all is to begin, to begin, to begin" (Barthleme 96). The self can never be satisfied or escaped, but only distracted through the continual creation of imaginary selves, substitutes, or projections, which are in principle satiable. "Not self-slaughter in the crude sense," says the protagonist of Barthleme's "Daumier," but "rather the construction of surrogates...the false selves in their clatter and boister and youthful brio will slay and bother and push out and put to all types of trouble the original, authentic self, which is a dirty great villain..." (214).

As the modernist writers were caught up in the revolutionary psychology of Freud, so the postmodern writers have been caught up in the revolution of quantum logic. Ever since Bergson translated Einstein's theory of relativity into psychological terms, physics and consciousness have been inextricably linked. However, the idea that we can never know the "ultimate" nature of reality is not new. Hume thought that the human mind could only interpret the world, not arrive at any definite knowledge of external reality. The cause and effect of classical logic reflected the operations of the human mind, not the external world. This idea is also the basis for William James' philosophy of pragmatism: all the mind can know is ideas; therefore, it is impossible for the mind to think about reality. All it can think about are its ideas about reality. A revolution in physics, paralleling this philosophy, has occurred in the last eighty-four
years. Quantum logic has replaced Newtonian logic as the dominant mode of thinking about the nature of physical reality. Says Frederick Turner in "Escape From Modernism," "the tradition of philosophy that saw us as cut off from our 'true' way of being has collapsed, although it hasn't realized it yet" (51).

The idea of multiple realities has found scientific expression in the "Many Worlds" theory of quantum mechanics. According to this theory, proposed by Hugh Everett, John Wheeler, and Neill Graham, all possibilities imaginable in the universe are real, and they all happen at the same time. Gary Zukav, in his study of quantum physics and Eastern philosophy, The Dancing Wu Li Masters, further defines this theory: Said another way, the Many Worlds theory defines any particular branch of reality which might "actualize" to us as a result of an interaction between an observed system and an observing system as merely one way of decomposing the wave function which represents them both. According to this theory, all of the other states which "could have" resulted from the same interaction did happen, but in other branches of reality. Each of these branches of reality are real, and, together, they constitute all the different ways in which we can decompose the universal wave function. (84)
Many contemporary American writers, such as Vonnegut, Barth, Gaddis, Gass, Sorrentino, Sukenick, and Hawkes have been influenced by the revolution of quantum logic. These writers operate at the edge of traditional mainstream American fiction and are often perceived as being anti-American in their concerns. However, according to Karl, "part of the reason our postwar (and earlier) novelists have such a difficult time relating to what is American is that the country offers so little of the middle, where novels traditionally flourished..." (19). What these writers have to offer is thoroughly American, not only in their concerns for traditional but contemporary themes. Karl believes they differ from the mainstream not only in their different approaches to contemporary "realities" but in their common purpose: "In all its diversity, the postwar novel has striven for precisely this achievement: to defamiliarize the familiar, to make the reader reinvent the world, and while moving human experience to the margins, to move the margins toward the center" (Introduction xi). Of these, and other contemporary American writers, no one embodies the postmodern American experience better than Thomas Pynchon.

Thomas Ruggles Pynchon, Jr., "is the most famous invisible writer since J. D. Salinger, the most admired since B. Traven, the most difficult since James Joyce" (Siegel 97). Pynchon's status as a literary recluse has only helped to increase his critical status. He has been called "the most gifted American novelist under 40" (Rosenbaum 26), "a novelist of
major historical importance" (Poirier 59) and is often referred to as an American literary Wunderkind. He has won the William Faulkner Foundation Award, the Rosenthal Foundation Award, a National Book Award, had a Pulitzer Prize overturned by the Pulitzer judges, and has refused the William Dean Howells Medal of the American Academy of Arts and Letters. His major work to date, Gravity's Rainbow (1973), has not only been favorably compared to Melville's Moby Dick and Joyce's Ulysses, but has been called "one of the best-realized paradigms of our century" (Sissman 138). All of this critical praise for a man whose biography remains largely speculative and whose last known photograph is over twenty-five years old.

Although the first book-length study of Pynchon did not appear until 1974, an impressive body of criticism has evolved about his works, mainly because the critic is relatively free to pursue whatever interpretive position he chooses. There are no interviews with Pynchon or essays written by Pynchon to "help" or "guide" the critic. Even though Joseph Slade has published Pynchon's 1968 correspondence with Thomas F. Hirsch of Boston University (shedding some light on Pynchon's obsession with the Herero Tribe of Southwest Africa) and Pynchon himself has written a surprisingly candid introduction to his new collection of early stories, Slow Learner: Early Stories, Pynchon critics are still arriving at widely diversified readings of his texts. Perhaps Pynchon has become so popular a subject for scholarly interpretation because, like his novel Gravity's Rainbow, he "offers no standard of ultimate reality or unreality. [He] remains plural, open to
any number of mutually contradictory, self-consistent, and non-exhaustive readings" (Hite 139).

Confronted with the overlapping, fragmented, and often contradictory mutually exclusive realities of *Gravity's Rainbow*, most critical efforts have been directed at explaining away the ambiguities, abstractions, and allusions contained in the novel's 760 pages. This type of criticism reached its largest expression with Douglas Fowler's *A Reader's Guide to Gravity's Rainbow*, in which Fowler ultimately admits the impossibility of cataloguing every reference in the novel. However, the main problem with Pynchon criticism to date (with few exceptions) has been the application of structuralist theory to a deconstructionist text. Most critics seem to take to heart Christopher Norris' definition of structuralism: "Interpretation is a quest for order and intelligibility among the manifold possible patterns of sense which the text holds out to a fit reader" (5). Ironically, in this "quest for order," most Pynchon critics have become like Pynchon characters: information gatherers and sorters, a kind of collective Maxwell's demon, searching for what Molly Hite calls "hidden structures' that will reveal what it all means" (Hite 4). As she points out in *Ideas of Order in the Novels of Thomas Pynchon*, the activity of reading *Gravity's Rainbow* "parallels the activities of the characters, with all the possibilities for irony attendant on this situation" (4). The structuralist approach to the novel presupposes that there is a single ordering principle buried in it and that it can be reconstructed from the fragments of the text by a "fit reader." The widely divergent conclusions that
critics have arrived at -- claims that the novel is structured along the ideas of thermodynamics, or information theory, or the rocket's parabolic flight, or the ideas of Henry Adams or Max Weber -- are only proof that *Gravity's Rainbow* is a novel of multiple principles and realities which coexist without resolving themselves into any single, coherent pattern. Each critic, in his own way, seems to declare with Eliot, "these fragments I have shored against my ruins" (67). Or as Lawrence Woolfley, in his article "Repression's Rainbow: The Presence of Norman O. Brown in Pynchon's Big Novel," has said: "For all this interest, the body of admiring commentary that has sprung up around [Pynchon] has so far failed to develop any coherent approach to [his] central meanings" (99).

Of course, not every critic has interpreted Pynchon in this manner. As early as 1965, Richard Kostelanetz wrote: "Pynchon's special achievement... is devising a symbol for metaphysical reality that suggests not ambiguity as, say, [the whale] *Moby Dick* does, but unbounded multiplicity" (3). It is this idea of "unbounded multiplicity" that later critics have had trouble with. In *Gravity's Rainbow*, Pynchon provides a system for reading the novel; however, this structural metaphor is akin to a trap for the reader to fall into in order for Pynchon to prove a point. As Molly Hite explains, "by providing the convenient handle of the structural metaphor, Pynchon duplicitously invites his readers to seize on an apocalyptic reading and in this way to confirm that humanity is eager to collaborate in its own betrayal" (131). The trap of the "apocalyptic reading" is the trap most critics have fallen into, the trap of attempting to sort out all of the multiple versions of
reality that the novel contains in order to arrive at some ultimate insight. Pynchon provides occasions of order. However, these occasions cannot be added up to any one system of universal order. Hite concludes, "the joke is that such an insight would also be disastrous...the ongoing project is one of making meanings, in the company of a vast panorama of characters engaged in the same activity" (141).

The "disastrous" insight that most critics have arrived at is the Second Law of Thermodynamics: the theory of growing disorder or "entropy" in the universe. Basically, the Second Law of Thermodynamics states that as a closed system moves forward in time there is a tendency for disorder to increase at the price of order. In The Education of Henry Adams, Adams portrayed the universe as a closed system, running down, out of control, to an eventual heat death: "Power leaped from every atom, and enough of it to supply the stellar universe showed itself running to waste at every pore of matter" (434). In 1960, Pynchon published a short story, "Entropy," which critics have used as evidence for an apocalyptic reading, not only of Gravity's Rainbow, but of the rest of Pynchon's work as well. In 1984, Pynchon himself has broken his usual silence to repudiate this view:

Because the story has been anthologized a couple-three times, people think I know more about the subject than I really do. Even the normally unhoodwinkable Donald Barthelme has suggested in a magazine interview that I had some kind of proprietary handle on it. Well, according to the OED the word was coined in 1865 by Rudolph Clau-
sius, on the model of the word "energy," which he took to be Greek for "work-contents." Entropy, or "transformation-contents" was introduced as a way of examining changes a heat engine went through in a typical cycle, the transformation being heat into work. If Clausius had stuck to his native German and called it *Verwandlungsinhalt* instead, it could have had an entirely different impact. As it was, after having been worked with in a restrained way for the next 70 or 80 years, entropy got picked up on by some communication theorists and given the cosmic moral twist it continues to enjoy in current usage. A pose I found congenial in those days -- fairly common, I hope, among pre-adults -- was that of somber glee at any idea of mass destruction or decline...given my undergraduate mood, Adams' sense of power out of control, coupled with Wiener's spectacle of universal heat-death and mathematical stillness, seemed just the ticket. (*Slow* 13).

The "cosmic moral twist" is the idea that the universe is irrecoverable. Entropy is the demon of Newtonian physics, a worldview that sees the universe as a closed system. But Norbert Weiner, one of the communications theorists Pynchon refers to, recognized in *The Human Use of Human Beings*, that the human body is not a closed system. And Gödel's Theorem, one of the cornerstones of modern mathematics, states that a closed system cannot exist; no system is
ever complete, and in order to complete it, one must go outside the system, destroying that system and creating a new one. Entropy, then, is a tendency for closed systems to increase in disorder. A pattern of disorder is not evidence of universal disorder.

Also, the possibility for time-reversal, although highly improbable, does exist. In the world of particle physics, the forward motion of time is an illusion; particles move forwards and backwards in time without regard for this “impossibility.” Entropy is not a concern in the quantum universe. It is merely one out of an infinite number of statistical probabilities. Quantum logic also suggests that consciousness is a quantum process. If so, then our entire notion of time comes under attack. One image in our society that suggests the possibility of time-reversal is the image of a film running backwards. *Gravity's Rainbow* is dominated by film images, sometimes to the point that critics have suggested that the novel is really a “film.” However, Pynchon uses film images, not to undermine novelistic conventions, but to suggest this notion of time-reversal — the film running backwards. The quantum universe, a universe of continual change and motion, is not irrecoverable.

As Molly Hite was the first to recognize, *Gravity's Rainbow* invites the reader to construct explanatory structures which ultimately mirror the reader's own nihilistic impulses. This, truly, is the genius of the novel. Pynchon offers deceptive structures and then satirizes the kind of mind that falls for them — by his own admittance, the pre-adolescent mind — and gives the novel a depressing, negative, nihil-
istic reading. *Gravity's Rainbow* is a novel acutely conscious of its readership, whom Joseph Slade in "Thomas Pynchon: Postindustrial Humanist" identifies as "the postindustrial society whose destructiveness is symbolized by lethal weaponry" (153) or a society Molly Hite sees as (in Pynchon's phrase) "Sold on Suicide":

*Gravity's Rainbow* confronts its readers with the spectacle of a post religious society committed to a vision of apocalypse, and duplicitously invites the reader to share this vision by trying to fit outrageous humor into a predestined tragic pattern. The comedy results from the fact that things do not fit. No conceivable providence can control the wealth and diversity of such secular history. (157)

Many critics, including Lance W. Ozier, Joseph W. Slade, and Peter L. Cooper have acknowledged Pynchon's allusions to quantum mechanics. Representative is Slade's comment: "Difficult, comforting perhaps only in the abstract, these [quantum] concepts nonetheless describe the universe more accurately than those of the past and thus represent models of freedom. Not much freedom, for the probabilities are that the world will continue rationalized" (67). Slade, like most critics, feels that Pynchon has lifted a few concepts from quantum mechanics to represent a slim hope in an otherwise hopeless universe. These critics have failed to take the whole of quantum mechanics, apply it to *Gravity's Rainbow*, and interpret the novel as metaphorically describing the universe as manifested through quantum logic. The key to a positive reading of the
novel lies in Pynchon’s use of quantum mechanics as literary metaphor. He recognizes that “Sold on Suicide” also signals an SOS.

To the Puritans, revelation meant election. God had his own system of order, who was elect and who was preterite, and the “revelation” of worldly success was the sign of election. The elect could control this system of order because their power was guaranteed by predestination: “The Elect, using this version of divine right, took over the system they had evolved by exploiting the Preterite, their power guaranteed by the Preterite belief in predestination” (Slade 157). The power of God’s Word, in reality man’s word, was used by the Puritans to secularize the wide diversity of nature into basic dualities which became the basis of the Protestant world view. Of course, there was no transformation from preterite to elect.

The Puritans, repelled by randomness and chaos, sought to control nature through this artificial structure. In Gravity’s Rainbow, Pynchon describes this natural world of chaos and cycles and chronicles why the Puritan mind-set sought to control it:

This is the World just before men. Too violently pitched alive in constant flow ever to be seen by men directly. They are meant only to look at it dead, in still strata, transputrified to oil or coal. Alive, it was a threat: it was Titans, was an overpeaking of life so clangorous and mad, such a green corona about Earth’s body that
some spoiler had to be brought in before it blew the Creation apart. So we, the crippled keepers, were sent out to multiply, to have dominion. God's spoilers. Us. Counter-revolutionaries. *It is our mission to promote death.* (720)

By reducing nature to such basic dualities as good/evil, elect/preterite and saved/damned, the Puritans destroyed the notion of a chaotic but organic unity of nature. Whatever did not fit into their established pattern of order was damned or destroyed, as Pynchon shows in *Gravity's Rainbow* with the story of Franz van der Groov, the seventeenth-century Puritan who virtually destroys the dodo bird population of Mauritius because the "stumbling birds [were] ill-made to the point of Satanic intervention, so ugly as to embody argument against a Godly creation" (110). Destruction and violence became a justified means of salvation.

Interestingly, what Newtonian physics did was confirm this Calvinist viewpoint through the scientific power to predict individual events. What Newton "discovered" were certain principles in nature that he gave mathematical expression to and that he claimed could predict the future from knowledge of the present. Like the Puritans, Newton abstracted certain principles from nature and claimed they were universal laws. The Universe became a clockwork machine, with every event, from the beginning of time until the end, predetermined, including man's illusion of free will. Newton claimed to make no hypotheses; his laws were derived from objective perception and anyone following his
experiments would come to the same conclusions. As any school child can recite, Newton was correct. However, a lesser known fact is that Newton was also a religious fanatic, a man who searched for the philosopher's elixir, read Jacob Boehme, thought there was a conspiracy of his enemies to deprive him of his theories, and finally concluded that God's divine plan in nature revealed a divine plot in history. Newton viewed history as a great religious drama outlined by the Biblical prophets. He himself prophesied an end to history in the year 2000, when we would witness the Second Coming and the Day of Judgement. No wonder Blake set up the "divine imagination" in opposition to the Newtonian clockwork machine, declaring:

> May God us keep
> From single vision & Newton's sleep. (English 166)

Pynchon feels that the Puritan mind-set is the basis for our present day society, which has evolved into the corporate structure of "They" and "Us." Or as Marcus Smith and Khachig Toloylan have commented, "the controlling idea of *Gravity's Rainbow* is that the world's present predicament -- the system of global terror dominated by ICBMs -- threatens to fulfill in historical time the apocalyptic and millenial visions which prevailed in the Puritan culture of colonial New England" (169). In connection with this idea, Pynchon introduces the theories of Max Weber. Weber believed that the Calvanistic ideal found its most exemplary expression in America. His ideas were also analogous to Newtonian physics and the laws of thermodynamics. Weber thought that political and economic systems were subject to the process of
“rationalization,” a process that mirrors entropy in that it is irreversible. As a system declined into disorder, it could be temporarily altered by the appearance of “charismatic” forces; however, after these forces had transformed a system, they too were subject to the process of rationalization. Weber saw the world as a closed system: “For Weber, there was something tragic in this process of rationalization, imposing design and pattern on nature, if only because he believed the process irreversible and inevitable” (Slade 155). Many critics, including Slade, see Pynchon as using Weber's theories as a metaphor for the Western world, a “gigantic, almost self-sustaining system with its own transformations and its own dynamic of order and disorder. Man the machine has created a world in his own image” (Slade 165). But Weber's point is not Pynchon's point. Pynchon believes that the process of rationalization is not irreversible. What Pynchon is interested in is the process of transformation.

The epigraph to Gravity's Rainbow is from Werner von Braun, former Nazi rocket scientist and head of the American space program: “Nature does not know extinction; all it knows is transformation.” While most critics have skipped over this epigraph, acknowledging only the irony of its source, I believe Pynchon is quite serious in his use of this statement. Not only does it alert the reader to Pynchon's theme of transformation, but it also reflects the basic world view of quantum mechanics and sets this view in direct opposition to the world view of the Puritans and Newtonian physics. The entire artificial Puritan structure is analagous to a giant closed system, subject to entropy and
the laws of thermodynamics. While this has been the dominant world view for over two hundred years, it is an artificial system, a pattern overlaid on nature, "another world laid down on the previous one and to all appearances no different. Ha-ha!" (Gravity's 664). But the world itself is not a closed system -- as contemporary literature reflects, it is a world of unbounded multiplicity, incapable of being contained in one all-encompassing structure. This contemporary view is given legitimacy by the science of quantum mechanics.

Unable to accept that disorder and randomness are a part of nature, Western man has created artificial structures which not only separate him from nature but try to control or counterfeit nature's dynamic cycle of birth-death-rebirth. Ironically, man's attempts to counterfeit nature led not to a rebirth, but only to death and disorder, the very concepts man set out to control in the first place. Newtonian physics only mimics nature's chaotic creative process, producing death, not life. As the opening of Gravity's Rainbow reflects, the dream of salvation is only a dream. *It is our mission to promote death.*

Most critics view Gravity's Rainbow through the concepts of Newtonian physics and come to a similar conclusion to Slade's: "Given the precarious permanence of the rationalized world, man can no more look on nature in her original pristine form than he can ever hope to completely control his destiny" (72). Pynchon's novel begins with the Newtonian world view of man as separate from nature, but it quickly progresses to the quantum mechanics' world view of man as integrated inside nature. Although Molly Hite and Peter L. Cooper have come close,
no critic has made the "quantum leap" to the fact that Pynchon's viewpoint is the quantum viewpoint. Going beyond the void -- in Pynchon's terms "beyond the zero" -- quantum mechanics finds a vision of unity in nature's continual cycles of transformation, as reflected in the world of particle physics. Each individual, in Wallace Stephen's phrase, becomes the "single artificer" of their own individual world. Pynchon's ultimate purpose is the transformation of the reader's sensibility, from the sterile, deterministic world of Newtonian physics to the unbounded multiplicity of quantum mechanics and the possibilities for transformation it contains. In quantum physics, transformation is no longer a dream. It is an everyday occurrence.
Chapter 2:
Quantum Mechanics: Playing Dice With the Universe

May the universe in some strange sense be "brought into being" by the participation of those who participate?...The vital act is the act of participation. "Participator" is the incontrovertible new concept given by quantum mechanics. It strikes down the term "observer" of classical theory, the man who stands safely behind the thick glass wall and watches what goes on without taking part. It can't be done.

--J. A. Wheeler

In 1900, the same year as Henry Adams' *The Education of Henry Adams*, a German physicist named Max Planck discovered the "quanta." While attempting to find out why objects changed color when their temperature was increased or decreased, Planck actually discovered "that there are changes in nature which do not occur continuously but in an
explosive manner" (qtd. in Zukov, Dancing 50). Classical physics held that energy radiated in a continuous line until it dissipated. What Planck had discovered was that electrons emit and absorb energy in small chunks or “quanta” and that these changes in energy levels are discontinuous. According to Victor Guillemin, in The Story of Quantum Mechanics, Planck “had to postulate that the energy of motion of each oscillator can neither build up or subside smoothly and gradually but may change only in sudden jumps” (50). Planck had found a dominant characteristic of nature, at the subatomic level, which violated Newton’s laws of motion.

The laws of Newtonian physics were thought to govern individual events. Viewing the universe as a clockwork mechanism, all predetermined by the law of cause and effect (for every action there is an equal and opposite reaction), the classical physicist could predict the outcome of each occurrence in the natural world. What Planck discovered was an event that violated this “law” of motion; there was no way to predict which individual electron would change its energy level, or “jump.” These changes occurred discontinuously and at random.

In 1913, Niels Bohr modified Rutherford’s planetary model of the atom by postulating that electrons revolve around the nucleus in orbits or shells. There are an infinite number of these shells, and each “quantum” jump that an electron makes from an inner shell to an outer shell requires a specific amount of energy. Eventually, the electron will return to its initial shell or “ground state.” Electrons absorb energy
when they jump and release the exact amount of energy they absorbed when they return to their ground state. Using Planck’s discovery, Bohr stated that electrons jump discontinuously, suddenly, without their energy levels running down to a zero state. This action of electrons absorbing and emitting energy discontinuously without a change in their original energy levels was incompatible with Newtonian physics.

While this action was not visible in the atomic world, at the subatomic level it was a dominant characteristic of nature. Linking the two worlds together, Einstein, explaining the photoelectric effect of light, described the nature of energy itself in quantum terms: light was composed of particles called photons, whose energy levels remained the same. Reducing the intensity of a light beam did not reduce the amount of energy, as Newtonian physics presupposed; it only reduced the number of photons. In quantum mechanics, energy does not run down in a linear pattern, but is both emitted and absorbed discontinuously in the same amounts. The velocity of light is constant: 186,000 miles per second. However, Einstein could not disprove Thomas Young’s theory that light was composed of waves. In 1924, Louis de Broglie merged the two theories together by proposing that matter has waves which correspond to it; in other words, particles are also waves. Light is neither a particle nor a wave, but both, and which component an observer sees depends on how he chooses to look at light. This duality or “paradox” put an end to Newton’s universal law of cause and effect.

In 1927, leading physicists met in Brussels. Through the influence
of Niels Bohr, the Copenhagen Interpretation of Quantum Mechanics emerged. According to this interpretation, a complete understanding of reality is not possible; a scientist can never know enough about an individual situation to make an accurate prediction of its outcome. As Gary Zukav has written, "quantum mechanics discards the laws governing individual events and states directly the laws governing aggregations" (38). While cause and effect may describe an overall pattern, it cannot explain the individual events that make up the pattern; these individual events occur at random. Einstein could not accept this interpretation and spent the rest of his life trying to formulate a "unified field theory" that would explain all of reality. In spite of Einstein, the Copenhagen Interpretation has become the standard interpretation of quantum phenomena.

In the same year, the German physicist Werner Heisenberg introduced the "uncertainty principle." In effect, Heisenberg said we can never know what really happens in the subatomic realm; all we can observe is what exists at the beginning of an experiment and at the end of an experiment. What we can observe between these two points is mere speculation. In scientific terms, we can never know both the "position" and the "velocity" of a particle at the same time. The more we know about the position of a particle, the less we know about its velocity, and vice versa, because when we use a light with a wave length short enough to locate an electron, we cause a change in its momentum. Any attempt to observe an electron changes either the position or
velocity of that electron. Heisenberg's uncertainty principle defeats the notion of an independent observer "safely behind the thick glass wall," watching nature run its course. As Niels Bohr wrote in *Atomic Theory and Human Knowledge*, this is "a final renunciation of the classical idea of causality and a radical revision of our attitude toward the problem of physical reality" (60).

Also, since the "observer" chooses which property of an electron he wishes to observe (either its velocity or its position), he now becomes a participant in the creation of "reality." The subatomic realm does not present itself as it "really is" to an observer. In fact, the very notion of an objective observer evaporates. The "participant" now sees the world as he chooses to see it because a particle has no independent existence as an object. The observer makes the connections which bring particles into existence. Without an observer to make these connections, things like particles do not exist. Einstein's wave-particle duality led to a new way of looking at the world and its relationship with ourselves.

Pynchon directly expresses this quantum point of view in his short novel *The Crying of Lot 49*. From a Newtonian point of view, Oedipa's quest for the Tristero, an alternate mail delivery service that may or may not exist, seems like paranoia. However, the Tristero does exist as a *relationship* which Oedipa observes (or projects), not as an independent entity. This is the quantum viewpoint. Tristero exists because Oedipa is there to make the connections. Thus it exists in the same way that particles "exist." Early in the novel Oedipa asks, "Shall I
project a world?" And that is exactly what she does. "Things" like Tristero exist as relationships between observables and not as independent entities because, in Zukav's words, "individual entities are idealizations which are correlations made by us" (72).

However, there still exists the problem of the second law of thermodynamics or entropy. Most critics see Pynchon as writing about a universe slowly running down via entropy to an eventual heat death. Later Pynchon critics like Peter L. Cooper see Pynchon's writings as a search for some loophole to counteract the irreversibility of this law. Jean Sylvain Bailly (1736-1793) was the first to speculate that all bodies must eventually reach a state in which all motion ceases. In 1824, Sadi Carnot, the son of Napolean's war minister, theorized in Reflections on the Motive Power of Fire that heat flows irreversibly from hot to cold bodies, eventually equalizing itself. Carnot, discussing this tendency as it applied to the steam engine, also theorized that this tendency applied to the rest of nature as well. Carnot came to his conclusions from the mistaken notion that heat was a weightless fluid that flowed between bodies of matter, a notion he later privately disowned. However, Lord Kelvin, in 1852, further confirmed this tendency toward the dissipation of mechanical energy, and in 1865, Rudolph Clausius called it "entropy," after the Greek root word for "transformation." According to his "second law" of thermodynamics, all energy, like heat energy, has a tendency to cool off into uniformity; eventually, the universe itself will cease to exist through this "heat
death."

The idea of entropy was, according to Jeremy Campbell in *Grammatical Man*, "an enormously appealing idea for nonscientists in the nineteenth century and afterward, suggesting as it did that chaos is the ultimate destiny of all things... It became a reference point, a metaphor, to which philosophers, theologians, and historians of that period returned again and again, with more enthusiasm than caution. This 'law' of physics, announcing that the universe is running down into a state of complete disorder, had a visible impact on intellectual fashions" (18). One impact was the search for a proof to counteract this new universal "law."

Pynchon is not the first person to search for a loophole in the second law. In 1871, James Clerk Maxwell proposed the idea of a being who sorted each individual molecule in a system to produce the energy necessary to drive a steam engine; since Maxwell's "demon" used only mental, not thermodynamic, energy, the second law was violated. Maxwell claimed that the demon violated the second law in that work was performed without any energy loss. Maxwell's argument was proven false in 1922 by Leo Szilard, who argued that the demon himself, as a closed system, was subject to the laws of entropy and that energy was expended in the gathering of information as well, producing as much entropy as the demon eliminated. However, Maxwell did introduce another notion into the science of thermodynamics, a notion that later scientists embraced: the idea that certain laws of nature are statistical, not
Scientists such as Willard Gibbs, building upon Ludwig Boltzmann's refinements of Maxwell's statistical theory, applied statistical probability to entropy and concluded that although the possibility for reversal of entropy statistically existed, entropy was the general outcome of the universe. The concept of reversibility, at least statistically, was acknowledged. This concept was later demonstrated in particle physics with the discovery of anti-particles, or particles which move backwards in time. Yet if we do not accept the metaphor of the universe as a mechanical device, and quantum mechanics does not, then the entire concept of entropy vanishes. Entropic effects may apply to an overall statistical pattern, but according to quantum mechanics, it does not apply to the individual events that constitute that pattern. Seeing the universe as an organic whole, quantum mechanics eliminates not only the rigid concept of cause and effect, but the entire notion of a universe running smoothly down to an eventual end.

What occurs in the quantum universe is a "dynamic (changing with time) unfolding of possibilities...we can determine, for any moment in the development of these possibilities, the probability of any one of them occurring" (Zukav 72). In mathematical terms this unfolding of possibilities is called a "wave function." The wave function describes all the possibilities that could occur within what is called the "observed system." An observed system continues to generate an infinite number of possibilities, in accordance with the Schrödinger wave equation.
Schrödinger believed that electrons were actually patterns called standing waves, which increased or decreased discontinuously. His theory claimed that standing waves were also quantized. The Schrödinger wave equation calculates the sequence of these standing waves as they develop over a period of time. Schrödinger also felt that his standing waves were real things, a position he later renounced when Max Born showed that since standing waves existed in more than three dimensions, they could only be seen as probabilities, not actual things. Born's theory is what gives quantum mechanics the power to predict probabilities; if we want to know the probability of any one of these possibilities occurring, we can calculate it using the Schrödinger wave equation and Born's theory of probability waves. We cannot accurately predict which possibility will occur because, according to Heisenberg's uncertainty principle, we cannot know both the position and velocity of an object at the same time (both of which are needed for an accurate calculation in Newtonian physics). Which probability materializes is a matter of chance -- we can only predict, statistically, which possibility is most probable.

This cycle of generating possibilities continues until the observed system is intruded upon by an "observing" system, i.e., a human observer. This "causes an abrupt, unpredictable transition to another state (quantum jump)" (Zukav 105). When an observing system intrudes upon an observed system, the wave function "collapses," reducing all possibilities, except one, to zero [and the probability of that one possibility "actualizes" into reality.] Or, according to the Pauli
Exclusion Principle, once a particular wave pattern forms, it excludes all others. Zukav further explains:

In principle, we can calculate a wave function representing an infinite number of events happening at the same time in an infinite number of dimensions. No matter how complex the wave function, however, as soon as we make a measurement, we reduce it to a form compatible with three dimensional reality, which is the only form of experiential reality, instant by instant, normally available to us. (77)

His point is a crucial one: there is no underlying "reality" available before the moment of observation, only an infinite number of possibilities represented by the wave function. In quantum terms, a particle does not exist until it is actualized at the moment the wave function collapses. Particles are tendencies to exist, with no existence outside the interaction of an observed system with an observing system. And even then, we only know it is a particle by its effects on a scientific measuring device; no one has ever actually seen a particle.

This collapsing of the wave function is discontinuous. It is a "quantum leap" from a reality with an infinite number of dimensions into a reality with only three dimensions. There is no law of cause and effect ruling which possibility will actualize; it is all a matter of chance. In quantum mechanics there are no "revelations," only the quantum leap, which actualizes one probability into the reality of relationships or
connections made by an observer. In Zukav's words, "the quantum leap is from a multifaceted potentiality to a single actuality" (75).

Quantum mechanics tells us that the world is not a stable object existing outside of us. The question of whether something does or does not exist is of no importance. According to Zukav, "the natural assumption that objects, like 'particles,' are real things that run their course in space and time according to causal laws regardless of whether we are around to observe them or not is repudiated by quantum mechanics" (198). How can light be both waves and particles? We are asking the wrong question. In theory, without the participation of a human observer, all possibilities exist in an observed system (the universe). In this quantum universe, there are no ultimate revelations, gained through observation, about the nature of reality. Any attempt to define reality is merely speculation on the observer's part. According to Heisenberg, all we can know is what happens at the beginning and the end of an experiment. There can be no speculation as to what occurs between these two states, except metaphorically. The paradox about the nature of light is only a paradox because we try to describe it in classical Newtonian terms. In Newtonian physics, an observer comes to a revelation about a segment of reality by observing it; in quantum physics, that segment doesn't exist until an observer observes it. And whether reality appears as a particle or as a wave, it is just a manifestation the observer has projected by interpreting a relationship between what he's observed. The only reality we can be sure of is what
Heisenberg, in *Physics and Philosophy*, calls "a strange kind of physical reality just in the middle between possibility and reality" (41).

This, then, is the standard or Copenhagen Interpretation of quantum mechanics. According to Bohr's theory of "complementarity," we observe our *interaction* with reality because particles and waves are not actual properties of light, but relationships developed out of our interaction with light. The idea of an independent observer is no longer relevant. As Heisenberg's uncertainty principle shows, we cannot observe reality without altering the reality we observe. The world exists as a set of interactions between an observed system and an observing system; particles and waves are not real things but properties belonging to these interactions. And without a participant to interact with, "things" like light do not exist.

The nature of the wave function is a subject of continuing debate in quantum mechanics. One of the more creative interpretations is the Many Worlds Interpretation of Hugh Everett, John Wheeler and Neil Graham (1957). According to Everett, Wheeler and Graham, the wave function is a real "thing," and all the possibilities it represents are realities that coexist in different dimensions. The wave function does not collapse; instead it splits off into different, mutually exclusive, realities. The Many Worlds Interpretation begins to sound similar to Karl's definition of postmodern literature as a literature of multiple realities.

However, it is in John von Neumann's *The Mathematical*
Foundations of Quantum Mechanics that the various means of interpreting the wave function and quantum mechanics itself are merged into "quantum logic." According to von Neumann, the wave function is not a "thing," but it is also more than an idea or metaphor. It occupies that strange middle ground that Heisenberg spoke of in Physics and Philosophy. Paradox in quantum mechanics is a matter of perception, not a matter of reality. For von Neumann, the problem with interpreting these paradoxes lay in language itself because language is a symbolic medium and "symbols do not follow the same rules as experience" (Zukav 261). Language, specifically metaphor, parallels experience, but it is not the experience itself. The classical point of view is akin to mistaking the shadows on the walls of Plato's cave for the outside world. Von Neumann demonstrated that the rules experience follows (quantum mechanics) and the rules language follows (classical logic) are different. His observations are the basis of quantum logic.

Quantum logic tells us that experience is never a question of dichotomies: either/or, right or wrong, illusion or reality. Classical logic limits experience to two choices: either/or. Its ultimate manifestation is the digital computer, which reduces all matters of choice down to two mathematical extremes, one and zero. However, in quantum logic, as represented by the wave function, there is always an infinite number of possibilities for each moment. Quantum logic, according to von Neumann the logic of experience, is interested in all possibilities that exist between one and zero. This is known as a
coherent supposition, defined by Zukav as "a thing-in-itself which is as distinct from its components as its components are from each other" (270). In quantum mechanics, "reality" is defined as a coherent supposition between the two extremes of one and zero. What von Neumann theorized was earlier implied in Einstein's General Theory of Relativity: that the human mind projects illusory structures upon the world of experience. Until von Neumann, classical logic was accepted as an accurate reflection of the nature of reality. With von Neumann comes the idea that the mind is capable of influencing reality. The classical mirror of art no longer reflects, but distorts; the observer becomes participant, creating what he sees in the mirror.

However, quantum mechanics does not replace Newtonian physics. The major drawback to quantum mechanics as a new, more accurate view of the world seems to be the fact that quantum physics only applies to the realm of subatomic particles. While particles may only be "tendencies to exist," the desk at which I am writing is surely a solid piece of matter existing in both space and time. Newtonian physics still applies to the macrocosmic world, the ultimate proof of this being the fact that without Newton's laws of motion there would never have been a rocket to take man to the moon. However, we are thinking in terms of classical logic here. In order to understand the far-reaching implications of quantum mechanics on the macrocosmic world, we must investigate the subatomic realm known as particle physics.

According to Einstein's famous equation E=MC², energy and matter are interchangeable. The subatomic realm is a world of energy or
particles continually appearing and disappearing in and out of existence. Or as Zukav explains, "the world view of particle physics is a picture of chaos beneath order. At the fundamental level is a confusion of continual creation, annihilation and transformation" (194). What, in classical terms, is known as matter is, on the subatomic level, being continually created, annihilated, and recreated. This is a version of nature's macrocosmic cycle of birth, death, and rebirth on a microcosmic scale. When two particles collide, both particles are destroyed, and in their place new particles, sometimes as large as the originals, appear. There is no entropic effect in the world of particle physics because even the tiniest particles contain a tremendous amount of energy, an energy whose dominant characteristic is transformation.

We are referring to particles, in their cycle of creation, annihilation, and re-creation, as if they were real "things." Particle physicists, however, refer to particles as "fields" that interact instantaneously and at a single point. This intrusion of one field into another is what we term a particle. The cycle of creation, annihilation, and re-creation is really the continuous interaction of fields. This view, that fields and not matter are the primary foundation of the universe, is called Quantum Field Theory. In Quantum Field Theory, "matter" is really the momentary manifestation of one field intruding upon another. We call this moment of intrusion a "particle." Thomas Pynchon, like Lawrence Durrell, calls it a "miracle."
My purpose in outlining the viewpoint of quantum mechanics is this: Pynchon has taken the philosophical and metaphysical implications of quantum theory and applied them in his work as literary metaphor for the modern world. Not one single critic has recognized this. Even Molly Hite, the best of recent critics on Pynchon, while acknowledging the presence of quantum mechanics in Pynchon's works, ultimately comes to her conclusions from a Newtonian point of view. Hite, like most critics, feels that Pynchon's characters are doomed questors who fail to reach the moment of revelation. In her article, "'Holy-Center-Approaching' in the Novels of Thomas Pynchon," she refers to the "Holy Center" as "the terminus of the quest, the epiphanic point in both time and space where the questing hero realizes the full meaning of his life, his search, and his world" (121). She concludes that no major character in Pynchon's works ever reaches this "Holy Center" because the quest is "an infinite approach, which brings the seeker closer and closer to a terminal revelation without allowing him to reach it" (121). Hite feels that the characters fail to gain revelation because revelation is impossible in a pluralistic world. And she is right. However, according to quantum mechanics, there is no such thing as a revelation about the "full meaning" of the world. Revelation is a classical term; like entropy, it does not apply in the quantum universe. By making a leap into the quantum point of view, we can see that Pynchon is not concerned with revelations, failed or otherwise. Pynchon's grand theme is transformation, a concept he metaphorically lifted from particle physics. And from a quantum point of view, several of his characters are quite successful in
their quest for transformation.

In *The Crying of Lot 49*, Pynchon parodies the quest for revelation and its modernist equivalent, the epiphanic moment. If we take the tone of the novel as serious, and we should not, then it becomes a story of Oedipa's continual approach and ultimate failure to reach a revelation about her dilemma: either Tristero exists or it doesn't exist. While Oedipa is at the threshold of a revelation several times, ultimately she never finds out the truth about Tristero because, according to Hite, revelation is impossible in a pluralistic world.

The novel exists, then, as a paradox. But quantum logic tells us that a paradox is only a perception, not a reality. From a Newtonian or classical point of view, Oedipa's quest is a failure. But if we look at the novel in terms of quantum logic, substituting the term *transformation* for *revelation*, quite a different picture appears, a picture that not only illuminates Pynchon's intent in *The Crying of Lot 49* but his intent in *Gravity's Rainbow* as well.

The opening of *The Crying of Lot 49* is told in a fairy tale tone, with ambiguous and non-committal language, undercutting not only the seriousness of the narrative but the concept of cause and effect as well. The narrator tells us that "as things developed, [Oedipa] was to have all manner of revelations. Hardly about Pierce Inverarity, or herself; but about what remained yet had somehow, before this, stayed away" (9-10). Yet ironically, Oedipa never reaches any revelation; her situation is reduced, it seems, to a set of either/or decisions with the outcome left undecided at the end. But in quantum logic, experience is never reducible
to a choice of two extremes because there is always at least one more alternative and, in most cases, an infinite number of possibilities for each moment. Pynchon is not interested in the two extremes, one and zero, but in that strange middle ground that exists between one and zero. What he is describing in The Crying of Lot 49 is the actualizing process that occurs when an observing system intrudes upon an observed system. Remember that, in the quantum universe, an observed system continues to generate an infinite number of possibilities in accordance with the Schrödinger wave equation until it is interfered with by an observing (human) system. The quantum "revelation" is that when these two systems meet, all possibilities are reduced to zero, except for the one probability that is actualized into reality by the observer forming a set of relationships. Interestingly, in The Crying of Lot 49, Pynchon defines a "miracle" as "another world's intrusion into this one" (88). The point of intrusion is what Pynchon calls being on the "threshold" of a revelation.

Early in the novel Pynchon demonstrates this. Oedipa (the observing system) descends into San Narciso (the observed system), "less an identifiable city than a grouping of concepts [or possibilities]," and finds herself "at the centre of an odd, religious instant" (12-13). Mistaking this moment as one full of "concealed meaning," Oedipa, like the reader, feels that a revelation "trembled just past the threshold of her understanding" (13). Oedipa senses that behind the facade of this Southern California community is an "intent to communicate." Yet the moment quickly passes without her ever discovering just what the
revelation might have been. What concealed meaning this moment intended to communicate to her becomes the focus of Oedipa's quest, and like her namesake, she sets out in search of the ultimate truth.

Oedipa eventually labels her "discovery" the Tristero System, "as if it might be something's secret title" (28). Note the use of the ambiguous "as if." She feels that somehow she has become "sensitized" to everything around her, either through her seduction by Metzger, the co-executor of Inverarity's will, or by "the other, almost offhand things" (29) around her. Comically, Pynchon has reduced everything Oedipa encounters to a series of either/or decisions, without ever telling us which one it is; he also describes Oedipa's search as "seriously" getting under way either with a letter from Mucho, her husband, or with the evening she spent with Metzger at a bar called The Scope. What makes Oedipa "certain" that her discovery is real is "the way it fitted, logically together...as if...there were revelations in progress all around her" (28). Not that there are, but as if there were.

Pynchon is using ambiguous language in order to undercut the very notion of an ultimate revelation. And Oedipa, initially, believes in the redemptive power of revelation. She believes in "some principle of the sea as redemption for Southern California...some more general truth" (37). Yet in her "seaward" journey she never reaches the sea. Instead, she winds up at Fangoso Lagoons, a manmade lake and housing development. Symbolically, Oedipa will never reach any revelation about her situation or find a redemptive power to transform her ambiguities into a general truth.
Pynchon uses the same technique as well to undercut the classical idea of cause and effect. Mike Fallopian's story about the Peter Pinguid Society, an organization centered around the first military confrontation between the United States and Russia in 1864, is a ridiculous example of historical cause and effect, full of the kind of either/or uncertainties that plague Oedipa's quest:

Popov did send out a ship, either the corvette "Bogatyr" or the clipper "Gaidamak," to see what it could see. Off the coast of either what is now Carmel-by-the-Sea, or what is now Pismo Beach, around noon or possibly toward dusk, the two ships sighted each other. One of them may have fired; if it did then the other responded; but both were out of range so neither showed a scar afterward to prove anything. (32)

The organization is founded on the fact that Peter Pinguid was the first casualty of such a confrontation; yet ironically, Pinguid was not killed, but after the battle merely "stayed in his cabin for weeks, brooding" (33).

Pynchon, then, is parodying the classical view of seeing the world in either/or terms. Either something is there or it isn't, and an independent observer can come to a conclusion through his observations. If the novel is viewed in this manner, then its conclusion is an exercise in frustration because we never learn if the Tristero is real or not. Yet surely Pynchon has an "intent to communicate," and what he intends comes through clearly from a quantum point of view: the irony of Oedipa's quest is that while she is trying to find out if Tristero is real or
not, by interacting with the world, she has made it real. Bohr's theory of complementarity leads to the conclusion that the world exists not as things but as interactions, relationships made by a participant. And in *The Crying of Lot 49*, that participant is Oedipa. It doesn't matter if the Tristero existed before or if it will exist after -- it exists now. Oedipa is asking the wrong questions. No single reality exists before the observed and observing systems meet; there is only the wave function or the moment and its infinite possibilities. And without perception, the world continues to generate possibilities according to the Schrödinger wave equation. Tristero exists as one of these possibilities until Oedipa, the observing consciousness, descends into San Narciso, the observed system, actualizing it into the one probability that arises out of the interaction. That it is the Tristero that actualizes is a matter of chance.

What the novel charts is Oedipa's making of the connections that actualize this probability into reality. Oedipa asks, "shall I project a world?", and she does exactly that.

According to quantum mechanics, the world exists not as independent things, but as a set of relationships formed through the interaction of an observed and an observing system. Pynchon uses Oedipa's "failed" quest for revelation as a metaphor to show this. As stated earlier, Pynchon is interested in *transformation*, and Oedipa has certainly transformed her life from that of a dull housewife to participant in an international conspiracy. At the end of the novel she finds herself at another interface between two worlds, and we now recognize that it is time for her to transform her life again. Later on, in
Gravity's Rainbow, Pynchon will call this "living at the interface," but what is important here is that he has adapted the quantum point of view as a metaphor for his fictional projection of the world.

In The Crying of Lot 49, then, Pynchon is interested in the interface between one and zero, the strange middle ground where everything is possible but nothing is actual. However, is Pynchon's adaptation of quantum mechanics valid? Quantum theory explains certain occurrences in the subatomic realm, but what does it have to do with the everyday world that validates Newtonian physics? In Gravity's Rainbow Pynchon will take the quantum metaphor and expand it even further, addressing this very question. For there is a very definite connection between the subatomic realm of quantum mechanics and the everyday world.

Both Bohr and von Neumann have shown that quantum mechanics and consciousness are ineradicably linked and that consciousness itself may be a quantum process. Von Neumann, in The Mathematical Foundations of Quantum Mechanics, showed that the rules of experience and the rules of classical logic are different. Experience is never an either/or proposition because there is always an infinite number of possibilities for each moment. Experience follows the rules of quantum, not classical logic. Quantum mechanics, then, not only explains the subatomic realm, but calls into question the very concepts of what we term "consciousness." It is not that the occurrences of the
subatomic realm merely violate Newton's physics; they also make us reconsider all concepts that we accept as reality or universal truth. In the words of Lincoln Barnet, "in the abstract lexicon of quantum physics there is no such word as 'really'" (qtd. in Cooper 156). Unfortunately, language cannot fully describe experience because, according to von Neumann, they follow two different sets of rules. The attempt to interpret and represent the world is no longer an act of language, but becomes an act of metaphor.

Norbert Weiner recognizes this process when he writes, in *The Human Use of Human Beings: Cybernetics and Society*, that contemporary scientific theories "represent a shift in the point of view of physics in which the world as it actually exists is replaced in some sense or other by the world as it happens to be observed" (30). For the quantum physicist, the world can only be described as metaphor. As Heisenberg pointed out, what happens between the beginning of an experiment and the end is a matter of speculation or metaphor. Pynchon recognizes this as well. However, he also knows that Heisenberg showed that observation is also disruptive of reality. In *The Crying of Lot 49*, Pynchon defines the act of metaphor as "a thrust at truth and a lie, depending where you were..." (95).

There is also a recent scientific theory that attempts to prove quantum mechanics as the valid way of viewing the everyday world. Bell's theorem takes the quantum idea that Newtonian physics cannot explain the happenings in the subatomic realm and applies it to the everyday world, stating, in effect, that Newtonian physics cannot
adequately describe the everyday world as well. Or as Zukav has written, "Bell's theorem not only suggests that the world is quite different than it seems, it demands it" (293).

What is different about the world is that quantum happenings suggest that information transfers between particles are instantaneous, that information gets around in ways different from those Newtonian physics dictates (perhaps Pynchon had this in mind when he made the Tristero an alternate mail system?). In other words, the "separate" parts of the universe seem to be connected in a way beyond cause and effect, an order beyond space and time. Einstein said that nothing could travel faster than the speed of light, yet information seems to travel between particles without a signal, faster than the speed of light. What happens in one part of the universe instantly affects what happens in another part. A local increase in information is accompanied by an instantaneous increase in information elsewhere, with no entropy because there is no signal to decay into disorder. Bell's theorem states that which probability arises out of the collapse of the wave function is not a matter of chance, but intrinsically connected with something that is happening elsewhere, and that the transfer of information between these two spaces is instantaneous. Pynchon alludes to this theory in *The Crying of Lot 49* with the dance of the deaf-mutes, who although they cannot hear the music, all react instantly to the "beat" as if there is some form other than aural communication occurring.

Theories of communication have also become quantum in nature. In contemporary information theory, only the probabilities of a message can
be computed, not which actual message will be received. According to Jeremy Campbell:

In making such a prediction, a mathematician considers not one future, but a multiplicity of simultaneous futures, all of which can be said to coexist in an abstract sense. Statistics can do nothing with a single piece of data. An isolated event has no meaning. It needs to be part of a pattern of many possible events, each with a certain likelihood of being realized. (28)

Norbert Wiener, along with Claude Shannon, one of the founders of contemporary information theory, recognized that an isolated item of information makes no sense. The listener is always in a state of uncertainty as to what the message will be, or as Campbell writes, "in the listener's mind, as in the statistician's charts and tables, are a number of possibilities or contingencies, some more probable than others. When the speaker sends his message, he makes one of these possibilities actual, excluding the others, and resolving the listener's uncertainty" (29). This not only reflects the quantum theory of transformation, but sheds further light on Oedipa's dilemma as well -- she, too, has the feeling that everything around her has an "intent to communicate," but as to the actual message being conveyed she remains in a state of uncertainty because it is impossible to predict, deterministically, which message will actualize. In information theory, the more unlikely the message, the larger the amount of uncertainty resolved or the greater the transformation. Oedipa becomes both speaker
and listener of her own message, and the message she projects is highly unlikely; therefore, the greater the transformation that occurs in her own life.

The parts of the world are connected in ways that Newton never dreamed existed. Or as Norbert Wiener wrote in / Am a Mathematician, "it became clear to me almost at the very beginning, that these concepts of communications and control involved a new interpretation of man, of man's knowledge of the universe, and of society" (325). Pynchon, through his writings, seeks to reorient the reader's perceptions toward seeing the fragments of postmodern reality as an unbroken wholeness of which everything is a form, a manifestation -- a "new interpretation of man." Zukav sums this up best when he says that quantum physics "itself has become a powerful metaphor" (315).
Chapter 3:
Getting Hit By Lightning: *Gravity's Rainbow*

We have already had to rethink so many of our concepts of motion, we will also gradually learn to realize that that which we call destiny goes forth from within people, not from without into them.

-- Rilke

The symbolic return to chaos is indispensable to any new creation...it is a sign that the profane man is on the way to dissolution, and that a new personality is about to be reborn.

-- Mircea Eliade

In the ten years since its publication, *Gravity's Rainbow* has been transformed by the critics into a contemporary literary classic. As John M. Muste points out in his recent article, "Singing Back the Silence: *Gravity's Rainbow* and the War Novel," Thomas Pynchon's encyclopedic effort "has already been the subject of more books, essays, and apoplexy
than any novel since *Ulysses*" (5). Yet even from the beginning, *Gravity's Rainbow* elicited uncommon praise. Reviewing the novel in *Library Journal*, Bruce Allen wrote:

> Here is my choice for the most important work of fiction yet produced by any living writer. It is an odyssey of discovery, a profound historical-cultural synthesis, a philosophical examination of the relationship of temporal and eternal... It seems to me the most demanding novel anyone has ever written, and it is surely among the most rewarding. Perhaps its least distinction is the certainty that it will outlast us all. (440)

Indeed, Pynchon's text seems to function like an isolated system, generating all kinds of possibilities according to Schrödinger's wave equation, until it interacts with an observing reader/critic. Then all of these possibilities are reduced to zero, except one: the one probability the critic actualizes into the reality of his interpretation. Muste's particular probability is interpreting *Gravity's Rainbow* as a war novel in the tradition of Hemingway, Dos Passos, Mailer, and Heller. My own probability is Pynchon's use of quantum mechanics as a literary metaphor for his fictional projection of the world.

Some critics have attempted to sum up the novel in one line phrases that serve only to reduce the complexity of Pynchon's vision. Josephine Hedrin, in *Vulnerable People: A View of American Fiction Since 1945*, calls *Gravity's Rainbow* "death's fantasy that life exists" (191). And Elaine B. Safer, who interprets Pynchon from the
point of view of the Black Humor school, feels that in *Gravity's Rainbow* "the real movement is not from death to any rebirth. It is from death to death-transfigured" (164). These critics ignore the fact that Pynchon is interested in exploring the multiplicity of possibilities that exist between the dichotomies of life and death. He is not taking sides. In *Gravity's Rainbow* he continues to explore the territory he initially charted in *The Crying of Lot 49*. As Joseph Slade says in *Approaches to Gravity's Rainbow*, nearly everything in *Gravity's Rainbow* has a dual aspect, in keeping with the novel's inquiry into the limits of paradox: "Western man may have reduced his world to dualities, to binomial codes, but, as Pynchon demonstrated in *The Crying of Lot 49*, resonant distances stretch between one and zero" (167). It is not for nothing that Pynchon calls the first section of *Gravity's Rainbow* "Beyond the Zero."

In *Gravity's Rainbow*, Pynchon expands the quantum metaphor he used in *The Crying of Lot 49* into an all-encompassing, multiple, quantum vision of the world. Alan J. Friedman says that Pynchon "presents the unifying view that all our pursuits are common responses to the same problem -- how to regard a universe that demands coexistence between extremes" (100). And in the 760 pages of the novel, over three hundred characters represent nearly every conceivable response to that problem, responses that attempt to systematize the unbounded multiplicity of nature into the one single reality that will solve the problem. However, as Frederick R. Karl has pointed out, "systems split off functions into separate roles" (456) and address
nature in either/or terms. Pynchon continues to parody this need to reduce reality down to simplistic choices ("You will want cause and effect. All right." [Gravity 663]), by pairing characters together who represent opposite viewpoints: Tchitcherine and Enzian, Pointsman and Mexico, Belaustegui and Franz Polkler all personify this duality and point to the idea of a multiplicity of world views.

In expanding his quantum vision, Pynchon not only transfers Oedipa's dilemma to Lt. Tyrone Slothrop, but also enlarges and expands it into the Hereros, a tribe of Africans transplanted into wartime Germany. Like Oedipa, Slothrop and the members of the Hereros have an acute sense of always having missed the messages: what Molly Hite calls a particular sensitivity "to the latent connotations in names and the ways these connotations set up new chains of associations...the act of naming sets up patterns that multiply implications without ever resolving into a single, culminating message" (152). Slothrop, like his Puritan ancestors, has "a peculiar sensitivity to what is revealed in the sky" (Gravity 26). And in this context, the Hereros become a microcosm of our contemporary society, a society Pynchon believes is "Sold on Suicide."

However, Pynchon also recognizes that "Sold on Suicide" is an S.O.S., and this hope takes the form of several different quests for a way to escape from the death sentence of linear, progressive time, into nature's cycle of birth, death, and rebirth. Pynchon's greatest achievement in Gravity's Rainbow is creating a symbol that reflects this wish for transformation: The Rocket. The Rocket, symbol of destruction and renewal, Newtonian and quantum physics, becomes our
contemporary symbol of multiplicity in much the same manner as Melville's White Whale came to represent the past century's concern with ambiguity. Although the critics disagree on how much the world has changed since then, most critics do agree that Pynchon's achievement is every bit as great as Melville's.

As I've stated previously, Pynchon's grand theme is transformation. Any search for revelation or resurrection is thwarted in *Gravity's Rainbow*. One of Slothrop's tarot cards is the Hanged Man, "who is supposed to be upside down to begin with" (*Gravity* 738), a symbol of rebirth, but Slothrop's card is *reversed* -- rebirth turned topsy-turvy. At its most basic level, the subatomic, nature is a continuing cycle of transformation: creation, destruction, and re-creation. Western man, sentenced to death by his linear concept of time, Sir Arthur Eddington's "arrow of time," dreams of salvation, resurrection, eternal life after death. Science, man's counterfeiting of nature's actions, can only mimic nature's biological transformations, producing death, not re-creation. Right from the Werner von Braun epigraph, the key word in *Gravity's Rainbow* is transformation: "Nature does not know extinction; all it knows is transformation." Pynchon also uses this epigraph to set up a contrast between nature and science, a contrast he develops in the opening of the novel. Pynchon goes to great lengths to set up his theme of transformation, as I believe a close reading of the beginning of the novel demonstrates. The title itself even suggests the process of transformation. *Gravity's Rainbow* is "the interface between one order of things and another" (*Gravity* 302).
However, implicit in all images of transformation (as Mircea Eliade points out in *Myths, Dreams and Mysteries* 80-81), is the idea of destruction, especially in the quantum image of transformation. Pynchon's Rocket becomes the perfect symbol of man's ultimate attempt and failure at the transformation only nature knows.

*Gravity's Rainbow* opens with an inversion of cause and effect: "A screaming comes across the sky" (3). By traveling faster than the speed of sound, the V-2 rocket violates Newton's law of cause and effect because the rocket's explosion occurs before the whistling sound that announces its arrival. As the narrator observes of Pirate Prentice, who sees a V-2 trail in the sky:

He won't hear the thing come in. It travels faster than the speed of sound. The first news you get of it is the blast. Then, if you're still around, you hear the sound of it coming in. (7)

As the novel opens, the blast of the rocket has occurred "off-stage." The reader, "hearing" the scream of the V-2, automatically becomes one of those who have survived the explosion. In a brilliant, one sentence introduction, Pynchon literally transforms the reader into one of the "second sheep, all out of luck and time" (3) who are hoping, through the evacuation of London, to be carried out to safety and salvation. However, left in an old iron hotel, each evacuee begins to realize that the "Evacuation" is "all theater": "you didn't really believe you'd be saved."
Come, we all know who we are by now. No one was ever going to take the trouble to save *you*, old fellow..." (4). By extension, the reader, whom Pynchon has made a fellow preterite, also realizes this message is directed to him as well.

However, Pynchon enforces his point even further when he reveals that the opening sequence is really one of Pirate Prentice's dreams. Rather than locate the reader into a firm fictional territory, Pynchon dislocates him as the introduction to the novel evaporates into Pirate's waking point of view: scattered around his flat, his "comrades in arms," looking "just as rosy as a bunch of Dutch peasants dreaming of their certain resurrection in the next few minutes" (4-5). But one of them, Teddy Bloat, falls through an opening in the minstrel's gallery, dropping into Pirate's bed. There is to be no ascension on this day, as gravity strikes. The dream of salvation, whether through evacuation or religion, is only a dream.

This failed hope of rescue from death is then contrasted to Corydon Throsp's plants, growing on the flat's roof. The biological transformation these symbolic plants achieve after death is not a resurrection, but a return "as fragments of peculiar alkaloids, to the rooftop earth, along with manure from a trio of prize Wessex Saddleback sows quartered there by Throsp's successor, and dead leaves off many decorative trees...all scumbled together, eventually, by the knives of the seasons, to an impasto..." (5) that becomes the rich topsoil that feeds Pirate's bananas and other future generations' growth. Thus we see the biological cycle of birth, death, and rebirth in Nature, as the old plants
are transformed into mulch, an unchanging, endless cycle of waste recycled into new life.

Pynchon's symbol of this natural transformation is "the soils stringing of rings and chains in nets only God can tell the meshes of" (6). This image of Nature's lifegiving rings is only one of several ring images in the novel and is directly contrasted to the artificial polymer aromatic ring, man's scientific mimic of nature. In trying to copy nature's rings, man has only succeeded in producing plastics, an artificial nature which only leads to death in the form of the rocket. In contrast to the great power station and the gasworks, "crystals grown in morning's beaker," producers of "gnarled emissions of steam and smoke" (6), Pirate's bananas thrive in the cold London winter. Like Wagner's golden rings, wrought through cursing Jove, man's artificial polymer rings are capable of rendering only death and destruction.

This cycle of nature reflects the concept of transformation in particle physics. What Newton called matter is actually, at the subatomic level, a continual cycle of particles being created, annihilated, and created again. Behind the visible, the macrocosmic world, "beyond the zero," is a world of energy appearing and disappearing in and out of existence, colliding, transforming, and then disappearing again. A continuous flow of creation, not a world drifting into an irrecoverable, entropic state. When two particles collide, they are both destroyed, and in their place new particles arise. But when man attempts to duplicate this cycle of transformation, only death and destruction occur. When the rocket collides with its target, both are
destroyed, in imitation of the particle process; there is no rebirth or transformation. Pirate knows this as he mulls over what it would feel like to have the Rocket hit him squarely on the skull. Like death, the rocket can never be escaped from, only temporarily halted. There will always be more. The Rocket, linked to the death symbol of the power station and gasworks through the crystal image of its exhaust, becomes Pynchon's symbol of man's ultimate attempt and failure at the transformation only nature knows.

Even in the face of ever-present death, Pirate's actions are still life-affirming. The odor of the "Banana Breakfast" that he cooks is life itself, reawakening, reasserting itself in the cold winter death of a World War Two London morning, like the genetic chains which "prove even labyrinthine enough to preserve some human face down ten or twenty generations" (10). The weaving of molecules, the particle cycle becomes a conjurer's trick through which, though not often, "Death is told so clearly to fuck off" (10). Nature's transformation is life regenerating itself through the dead past like the bananas growing out of the "dead" past of the plant mulch.

The opening of _Gravity's Rainbow_ then, while critical of traditional notions of resurrection and salvation, presents a positive image of life-affirmation, through the quantum idea of transformation. There is no defeating death through mythical salvation, only an occasional "fuck-off" from a human face preserved down ten or twenty generation, a macrocosmic image of a microcosmic phenomena. Pirate's Banana Breakfast is a "southern island well across a tropic or two from
chill Corydon Throsp's mediaeval fantasies" (10), and as the narrator asks, "is there any reason not to open every window and let the kind scent blanket all of Chelsea?" (10). Contrary to the mostly "doom and gloom" critical readings of the novel, I see Pynchon's purpose in Gravity's Rainbow as an attempt to "open every window" and blanket the entire world with this life-affirming message of transformation.

Pirate also has a "strange talent for -- well, for getting inside the fantasies of others: being able, actually, to take over the burden of managing them" (12). He is able to take over the fantasies of those people who may be useful to the government in the war effort, so their fantasies don't get in the way: "It is a gift the firm has found uncommonly useful: at this time mentally healthy leaders and other historical figures are indispensible" (12). However, Pynchon calls these fantasies and daydreams "tropical refuges" linking them to the life-affirming tropical image of the bananas. Removing them leaves these "healthy" leaders capable only of thoughts of death, destruction, the War.

The first VIP fantasy Pirate managed belonged to Lord Blatherard Osmo, who occupied the "Novi Pazar desk" at the Foreign Office prior to the War. Osmo's fantasy is of a giant Adenoid devouring "London, perhaps all England" (14). This fantasy introduces the paranoid idea of a "master plan," a recurring theme in Pynchon's work: "Not swallowing up its victims at random, no, the fiendish Adenoid has a master plan" (15). Ironically, Pynchon relates this selective process to the Puritan idea of election/preterit that he develops throughout the novel: "it's choosing
only certain personalities useful to it -- there is a new election, a new preterition abroad in England..." (15). Symbolically, the giant Adenoid also represents the German war monster that is devouring London during the War with a Blitz of bombs and, later, rockets. This dream sequence also echoes the novel's opening dream sequence in that there is "a half-hearted attempt to evacuate London" (15) because of the Adenoid's threat. As in the opening sequence, only the VIP's are evacuated. But Pirate does his job, saving England from the "Balkan Armageddon the old men dreamed of, giddy in their beds with its grandeur" (16), but not from World War Two. For there are a million bureaucrats "diligently plotting death and some even know it..." (17), and there is no way Pirate can control all of their fantasies.

Pynchon introduces the protagonist of Gravity's Rainbow, Lt. Tyrone Slothrop, through the spy Teddy Bloat, who is on a mission to photograph a map of London on which Slothrop has "starred" his sexual conquests. Bloat wonders if the colored stars on Slothrop's map are important or if the colors are random, uncoded, if "it mightn't make a difference, though he knows of no one he can ask" (19) that the stars "cover the available spectrum" (19). Ultimately, the question is unanswerable because Bloat is using black and white film: "Too bad whoever's funding this little caper won't spring for color film" (19).

Once again, we see Pynchon introducing the idea of either/or thinking, so predominant in The Crying of Lot 49, and then undercutting it. We now know that Bloat is asking the wrong question. As Pynchon demonstrates, we can never really know which choice is right because there is always another variable other than one or zero
available: in this case, the fact that Bloat only has black and white film. Either/or questions have become a symbol for the clash between the Newtonian world view and the quantum world view.

In typical Pynchon fashion, Slothrop's name is quite suggestive, not only of the Biblical sin of sloth, but of a related modern "sin," entropy, as well: S-L-O-T-H is an anagram for the Second Law of Thermodynamics, as Daniel Simberloff points out in "Entropy, Information and Life: Biophysics in the Novels of Thomas Pynchon" (617). Like Pirate, Slothrop's actions are, in the midst of ever-present death, life-affirming as well. While investigating various rocket-bomb disasters for ACHTUNG (Allied Clearing House, Technical Units, Northern Germany), an agency attempting to "halt" the war, Slothrop still has the time, "in his travels among places of death, to devote to girl-chasing" (19). And also like Pirate (who "reads" other people's dreams), and other characters such as Eddie Pensiero (who reads shivers), Saüre Bummer (who reads reefers), and Thanatz (who reads whip scars), Slothrop is an information sorter. Only he is gathering information about the V-2's, in order to attempt to understand his "situation." But Slothrop, like his name implies, is too slow to process all this information into some concrete explanation. He is not a digital machine making choices about one and zero.

What Slothrop does link the V-2 rocket to is an image of death inscribed on the tombstone of one of his Puritan ancestors, Constant Slothrop: "On the old schist of a tombstone in the Congregational churchyard back home in Mingeborough, Massachusetts, the hand of God emerges from a cloud, the edges of the figure here and there eroded by
200 seasons' fire and ice chisels at work, and the inscription reading... 

Death is a debt to nature due/Which I have paid, and so must you" (26).
This leads to Slothrop's conviction that that's how death is, "the great bright hand reaching out of the cloud" (29). Only now, that hand is man-made, man-projected, the bright exhaust of the rocket as it drops out of the sky. Earlier, Pirate had asked, in reference to the V-2's, "will we have to stop watching the sky?" (8), and in light of the evidence on the tombs of Slothrop's ancestors, including Mrs. Elizabeth Slothrop's epitath, "Mark, Reader, my cry! Bend thy thoughts on the sky" (27), this question takes on a greater significance.

Pynchon also uses Slothrop's memories of his ancestors' graves to introduce the Puritan philosophy of life and death, elect and preterite, the Puritan notion of predestination. To the Puritans, God had his own system of order, who was elect and who was preterite. The signs of election were worldly success: if you were rich and privileged, you were elect; if not, you were forever damned. And in this Puritan scheme of things, there was no transformation from preterite to elect. Repelled by nature's continuing cycle of random transformations, the Puritans sought to control nature through a system given legitimacy not only by the presence God, but by Newtonian physics as well. Newton's vision of the universe as predestined and predictable only further fueled the Puritan rage for order.

Pynchon is interested in Puritanism not only because it is the foundation of America (witness the recent resurgence of the ghost of Puritan ethics in the rise of contemporary religious fundamentalism) but because he is interested in all of man's various methods for
counterfeiting or controlling nature’s cycle of transformations, whether it be through organic chemistry, religion, thermodynamics, film, or calculus. These attempts are static, controlled, linear, systematized, while nature’s transformations are random, dynamic. And because these systems are linear, they become subject to the probability of entropy, of the overwhelming probability that they will disintegrate into decay and disorder instead of increasingly ordering the world. From the point of view of all systems which see man as outside nature, nature has a tendency to decline into a disorder which the system will control. However, quantum mechanics sees man as an integrated part of nature. Quantum mechanics harmonizes with the universe, and like nature, its transformations are dynamic.

Most critics, like Joseph Slade in his article “Thomas Pynchon: Post-Industrial Humanist,” deal with how modern science has “modified Newton in crucial respects” (67). But “modified” is the wrong term. Quantum mechanics recognizes that the Newtonian point of view is inadequate and seeks to posit a completely different world view. Slade comments that “man can no more look on nature in her original pristine form than he can ever hope to completely control his destiny” (72) -- this is still the Newtonian point of view, seeing man as outside nature. Like quantum mechanics, Pynchon seeks to transform man back to being an integrated part of nature, in touch with nature's cycle of birth-death-rebirth, a random cycle that systems such as Puritanism sought to do away with. Gravity’s Rainbow traces Slothrop’s transformation from a basic Newtonian point of view to a quantum point of view.
Pynchon begins this transformation with another reversal of cause and effect. It seems that Slothrop, like Pirate, has a unique gift. Only Slothrop's is much more threatening to "the Firm" because it defies Newton's "law" of universal cause and effect: wherever Slothrop experiences an erection, a V-2 rocket later falls. To the Firm, to "Them," Slothrop's erections seem to be causing the rockets to fall. Ridiculous as this all sounds, "They" take it very seriously, and Teddy Bloat's photographing of Slothrop's map is the first step they take in confirming this suspicion.

Because of his "gift," Slothrop begins to experience paranoia, begins to become obsessed of the idea of a V-2 rocket with his name on it. He thinks that "They" are out to get him ("'They' embracing possibilities far far beyond Nazi Germany" [25]) and that it "doesn't cost them a thing to paint his name on every one, right?" (25). Having survived the Blitz, Slothrop feels that his "debt to nature" is four years overdue, when one iron afternoon in London, the sky still humming from what proves to be his first V-2 rocket, he notices he has a hardon..."say, what?...well great God where'd that come from?" (26). According to Pynchon, Slothrop, like every man, is in love with the idea of his own death. And like each of his ancestors, he sees each man, each biological creation, "in turn paying his debt to nature due and leaving the excess to the next link in the name's chain" (27). While Slothrop becomes a kind of Everyman, the Slothrops, a family of timberscutters, producing man-made paper products from nature's trees, come to symbolize the overwhelming majority of Americans, the preterite:

They were not aristocrats, no Slothrop ever made it into
the social register or the Somerset Club -- they carried on their enterprise in silence, assimilated in life to the dynamic that surrounded them thoroughly as in death they would be to churchyard earth. Shit, money, and the Word, the three American truths, powering the American mobility, claimed the Slothrops, clasped them for good to the country's fate. (28).

And like these preterite, the Slothrops "did not prosper... about all they did was persist" (28).

Earlier, in his youth, Tyrone had seen the Northern lights in the sky, and "they scared the shit out of him" as he wondered, "were the radiant curtains just about to swing open?" (29). Then in 1931, waking from a dream of these terrifying Northern Lights, he saw the embers from the Great Aspinwall Hotel fire falling across the sky like a meteor shower. And now, in London, seeing the V-2 rocket in the sky, he wonders, "what lights were these? What ghosts in command?" (29). Like Oedipa looking down into the valley of San Narciso, Slothrop is at the threshold of a revelation, one world's intrusion into another, the miracle moment. The Rocket, an observed system, has met Tyrone Slothrop, an observing system. Although this scene parallels the earlier scene with Oedipa in *The Crying of Lot 49* in a number of respects, Pynchon goes out of his way to make sure we notice this moment. Twice he mentions the exact time of the moment: "The Moment was 6:43:16 British Double Summer Time... 6:43:16 BDST" (26, 28). This is the quantum moment and its infinite number of possibilities: "In the sky right now here is the same unfolding just about to break through..." (29). As with Oedipa,
there is no ultimate revelation for Tyrone about this moment even though
his face is deepening with its light, everything about to rush away and he
to lose himself..." (29). As John Ashbery would say, Tyrone's destiny is
"to return unfruitful out of the lightness/That passing time evokes"
(Double 13). There is only Tyrone, the observing system, causing one of
these infinitely unfolding possibilities to actualize into a probability. As
the narrator says, "this is how it does happen..." (Gravity 29). In
quantum terms, this pinpointed moment is the interface between two
systems, the observing system intruding into the observed system,
actualizing one probability out of the infinite number of possibilities an
observed system generates according to the Shrödinger wave equation.
And as if to further emphasize this point, the next scene in the novel is a
seance -- the willful manipulation or attempt by man to get one world to
intrude into another (in this case the world of the dead and the world of
the living) to try and bring about the moment and its possibilities. But
as with all of man's efforts to mimic nature's cycle of transformation,
the seance does not bring rebirth or resurrection, but only a direct
communication with death.

Pynchon further elaborates this idea of attempting to manipulate
the intrusion of one world into another (or forced transformation) with
the episode of the Polish undertaker. Inspired by an American propaganda
leaflet on Benjamin Franklin, the unnamed undertaker becomes obsessed
with the idea of being struck by lightning. One night he rows out to sea,
into a storm, dressed in "a complicated metal suit, something like a
deep-sea diver's, and a Wehrmacht helmet through which he has drilled a
couple of hundred holes and inserted nuts, bolts, springs and conductive
wands of many shapes so that he jingles whenever he nods or shakes his
head, which is often" (663), where he picks up Thanatz, who has been
washed overboard from the Anubis, a ship on which he has been a
passenger along with Slothrop. Accompanied by "death" personified, the
undertaker -- who is "a digital companion alright, everything gets either
a yes or a no" (663) -- seeks to bring about in his own life the
transformation only nature knows.

Pynchon refers to the "survivors" of the intrusion of an observing
system into an observed system (like Slothrop) as the "lightning-struck." Using images from calculus, such as continuity, delta-t, and singular
points, he defines what the intrusion of one world into another or a
"miracle" is. Lance W. Ozier, in "The Calculus of Transformation: More
Mathematical Imagery in Gravity's Rainbow," feels that these
"mathematical references in Gravity's Rainbow provide a pattern of
imagery that reveals coherence where there is dissolution ...and the idea
of transformation they suggest constitutes an affirmation that is true to
Pynchon's view of the world" (194) a view which, of course, is the
quantum point of view. These images from calculus suggest "the idea of
transformation" because calculus is a mathematical representation of
infinity, and images such as delta-t represent changes or
transformations in time. For Pynchon, delta-t represents approaching
destiny or revelation. This is evident earlier in the novel when Leni
Pölkler, who participates in pre-War demonstrations in Berlin to feel the
thrill of potential annihilation by the police, tries to explain to her
husband Franz (who is a "cause-and-effect" technician) about the moment when fear dissipates into the imminence of death:

She tried to explain to him about the level you reach, with both feet in, when you lose your fear, you lose it all, you've penetrated the moment... the moment and its possibilities.

She even tried, from what little calculus she'd picked up, to explain it to Franz as $\Delta t$ approaching zero, eternally approaching, the slices of time growing thinner and thinner, a succession of rooms each with walls more silver, transparent, as the pure light of the zero comes nearer... (*Gravity* 158-159)

Transformations in calculus take place in infinity, allowing us to reduce the infinite down to a measurable quantity. It gives the same results as if we were able to do an infinite number of calculations; the same results as if $\Delta t$ had reached zero. However, $\Delta t$ is a non-zero entity that can never actually reach zero, and Pynchon uses this metaphor to reinforce the idea that there is no ultimate revelation about the nature of reality available. This $\Delta t$ image has even greater significance at the end of the novel, when the Rocket is plunging down into the theater in which "society" sits, mistaking the film images on the screen (from which the Rocket has broken free) for reality.

Few people have been hit by lightning, and fewer have lived to tell about it. But like the Polish undertaker, we can imagine "what stories *they* could tell!" (663). Most people's lives, like the undertaker's, are "a
matter of continuity...ups and downs that are relatively gradual, a sinuous curve with first derivatives at every point. They're the ones who never get struck by lightning" (664). In other words, most people never experience the sudden transformation that occurs when an observing system intrudes into an observed system, reducing an infinite number of possibilities down to one probability. However, the lightning-struck, those who have experienced this transformation, "experience a singular point, a discontinuity in the curve of life" (664). In calculus, a singular point is another image of timeless infinity, but also an image that represents the moment when one world is transformed into another, the moment, in quantum mechanics, when the wave function collapses. And, as in particle physics, the singular point is a moment of destruction— but a moment of destruction filled with potential. As Cooper has pointed out (in referring to Eliade's influence on Pynchon), "man transcends profane existence in apocalypse" (Signs 69). The images of Δt and singular points are images which not only reflect this, but also reflect the natural (and quantum) cycles of creation, annihilation, and re-creation.

To a cause-and-effect man like Franz Pölker, these moments of destructive transformation, like the moment when one is struck by lightning, reflect only annihilation from this world. Although the undertaker is a cause-and-effect man, he is actively (perhaps a little too actively) seeking transformation to another reality, "another world laid down on the previous one and to all appearances no different. Ha-ha! But the lightning-struck know, all right! Even if they may not know
they know" (Gravity 664). However, his quest is doomed to failure because he is seeking to become one of the lightning struck in order to help him with his job: "Can you dig that, gates? He wants to know how people behave before and after lightning bolts, so he'll know better to handle bereaved families" (665). As Pynchon makes clear, man cannot participate in nature's cycle of transformation because it requires death; but as Ozier says, each "singularity brings or requires a death which offers transcendence rather than mere entropic dissolution into chaos" (205). From the cause-and-effect point of view, destruction leads only to nothingness. But from the quantum point of view, from the point of view of the lightning-struck, destruction leads to transformation and re-creation. Ironically, man's attempts to mimic nature's cycle of birth-death-rebirth lead only to the very destruction man fears in nature.

Of the over three hundred characters in Gravity's Rainbow, there are few who are "lightning-struck," but these few characters counterpoint the overwhelming masses whose mission it is to promote death. Leni Pökler is one of these who accept "the moment and its possibilities." Her life goes through several transformations where she, like Oedipa, (in the words of Rilke, one of Pynchon's major inspirations) exists at

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just some unmeasurable
moment of time
between two whiles
when she had existence
completely
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down to her fingertips! (Duino, "Seventh Elegy 64-65)

Although not all of her transformations are positive (at one point she is transformed into a prostitute in order to survive after the war), her life does reflect the cyclical transformations of nature and particle physics and not the entropic rush of the Newtonian world.

Another of the lightning-struck is Beláustegui, the engineer who is a counterpoint to Leni’s Newtonian technician husband Franz. Beláustegui is a gambler, a man who knows the odds:

the shapes of risk are intimate to him as loved bodies. Each moment has its value, its probable success against other moments in other hands, and the shuffle for him is always moment-to-moment. He can’t afford to remember other permutations, might-have-beens -- only what’s present, dealt him by something he calls Chance. . . . He will stake everything on this anarchist experiment, and if he loses, he’ll go on to something else. But he won’t hold back . . . he’s a source of strength. (613).

Here, Pynchon uses the image of shuffling a deck of cards to represent the observed system generating an infinite number of possibilities. There is no way for Beláustegui to predict, from past shuffles, which cards he will be dealt; each shuffle is “moment-to-moment,” and the best
he can hope for is the probability that he will be dealt a successful hand. Because he accepts this "quantum" point of view, Belástegui is "a source of strength."

Although Belástegui is a minor character, his point of view is major and is best personified in the statistician Roger Mexico. Unlike his boss, Edward Pointsman, a strict Pavlovian whose entire belief system is threatened not only by Slothrop's existence but by the unpredictability of exactly where a rocket will fall, Mexico sees Slothrop and the rocket's unpredictability as justifications for the new science he deals in, statistical probability. Although Newton's laws of physics were used to develop the V-2 rocket, German scientists soon found out that while the rocket could be aimed at a specific target, once its fuel burned out (brenschluss in German) Newton's laws could no longer control the exact trajectory and striking point of the rocket. The V-2, then, a macrocosmic object, existed as a paradox because it operated using both the laws of Newton's physics and the physics of quantum mechanics. By using statistical mechanics, scientists like Mexico could calculate the probability of where a rocket would strike, its mean average path, by using a mathematical formula called a Poisson distribution. Put simply, a Poisson distribution predicts the odds of how many rocket strikes will occur in a given area. It cannot accurately predict the exact number of strikes in that area because each strike is an independent entity and thus the odds of how many rockets will fall always remains the same. There can be no revelation about the rocket strikes, only the probability of a particular strike falling in a particular
area. As the behavior of particles disproved the Newtonian notion of the predictability of individual events on a microcosmic scale, so the Rocket disproved it on a macrocosmic scale.

Mexico keeps a map of London on which he has marked V-2 rocket strikes in red circles according to a Poisson distribution curve. This map is the subject of an argument between Mexico and Pointsman, who cannot understand why each individual strike cannot be accurately predicted. Mexico is the "Antipointsman," contradicting Pointsman's deterministic beliefs as much as Slothrop's existence does. Pointsman can only acknowledge the existence of the one and the zero:

He cannot, like Mexico, survive anywhere in between. Like his master I.P. Pavlov before him, he imagines the cortex of the brain as a mosaic of tiny on/off elements...each point is allowed only the two states: waking or sleep. One and zero...all Pavlovian brain mechanics -- assume the presence of these bi-stable points. But to Mexico belongs the domain between one and zero --the middle Pointsman has excluded from his persuasion -- the probabilities. (55)

While Pointsman believes in the "true mechanical explanation" ((89), the ideal of Pavlovian determinism, Mexico has "a feeling that cause-and-effect may have been taken as far as it will go...the next great breakthrough may come when we have the courage to junk cause-and-effect entirely and strike off at some other angle" (89). This
other angle is confirmed when Mexico’s map is overlaid on Slothrop’s and the circles and stars match exactly:

It’s the map that spooks them all, the map Slothrop’s been keeping on his girls. The stars fall in a Poisson distribution, just like the rocket strikes on Roger Mexico’s map...but, well, it’s a bit more than the distribution. The two patterns also happen to be identical. They match up square for square. (85)

The fact that “a star always comes before its corresponding rocket strike” (86), challenging the existence of Newton’s law of cause and effect, is what makes Slothrop such a threat to “Them.”

Because Mexico is the only major character in Gravity’s Rainbow who consciously holds the quantum point of view, he is also the only character whom Pynchon allows to carry on a relatively normal love affair, with all the redeeming qualities that Western culture associates with love. Although this affair with Jessica Swanlake ends with the ending of the War, Mexico later goes on to form “The Counterforce,” an organization dedicated to fighting the system (personified as “Pernicious Pop”), recognizing the inevitability of systemization but demanding a continual interruption of all systems. When we last see Roger Mexico, the final transformation of his life Pynchon allows us to see, he is standing on a corporate conference table, pissing on the chairman of the board of “Them.”
Like Tyrone Slothrop, Vaslav Tchitcherine and Enzian and the Hereros are involved in a quest for "The Rocket" in the Zone of post-World War Two Germany. These rocket quests are based on reality. Immediately after the War, both the United States and the Soviet Union sent special forces into German to recover not only intact V-2 rockets but the scientists who operated them. Chief among our "captures" by the "T-force group," who succeeded in capturing a large number of intact V-2's, was Werner von Braun, head of the Nazi rocket program and former assistant to Herman Oberth, leader of an organization of scientists and civilians who dreamed of using the rocket as an instrument of transcendence -- space flight. In 1932, von Braun switched allegiances to General Dornberger's military project of using the rocket as a weapon. Pynchon uses this historical occurrence to represent death's winning out over technology's dream of mimicking nature's cycle of transformation.

Tchitcherine's failure to find the Rocket is representative of the Soviet Union's general failures at capturing intact V-2's. Like Enzian, his half-brother, and like Slothrop, Tchitcherine has the sense that he is "always to be held at the edges of revelations" (566). He manages to survive several attempts on his life because he allows chance to rule his fate. He is described in chemical terms, as being open to the moment and its possibilities: "He is a giant supermolecule with so many open bonds available at any given time" (346). That he is often linked with organic chemistry may be one of the reasons for his failures as well; like V., he becomes mechanical, having his wounds replaced with alloy parts.

His half-brother Enzian, a Herero tribesman named after a
multi-booster rocket the Germans never developed and the Gentian flower (which figures prominently in Rilke's poetry), comes closest to achieving the quest for the Rocket. However, Enzian and the Hereros are searching for a special Rocket, the "00001," or Primeval Rocket that will return them to a mythical time when there was a unity between language and reality, a time of cyclical renewal. Via this rocket, the Hereros are seeking to bring about a transformation from the Western linear concept of time in which they have through colonization become trapped, to Nature's cycle of birth-death-renewal.

Enzian believes that "somewhere, among the wastes of the world is the Key that will bring us back, restore us to our Earth and to our freedom" (557). He eventually constructs an instrument to carry his people back to the center of cyclical return, the 00001, out of waste materials, the tail of the 00001 duplicating the Herero mandala -- a magical re-creation of the world -- in order to show one group of Hereros, the "Empty Ones," there are ways of returning to Earth's cyclical processes other than tribal suicide. Again, Pynchon has based his fiction on historical fact. In a letter to Thomas F. Hirsch, he stated that the real Herero's death wish came from a religious orientation which led them to feel that mankind was an integrated part of all creation, and that tribal suicide would seem plausible given this mystical vision of the universe. However, mass suicide, a return to the "zero," is as crazy a vision of transformation as Enzian's dream of the Rocket as an instrument to carry his people back to a mythical past.

In view of so many characters failing to reach a revelation through
transformation, most critics, like Hite, feel that Pynchon is writing about the impossibility of achieving revelation in the fragmented modern world. According to this point of view, the biggest failure in the novel is the protagonist, Tyrone Slothrop. Not only does he fail to find the object of his quest, the Schwartzgerät (literally "black box"), he forgets what he was searching for and eventually disintegrates into a non-recognizable form. But from the viewpoint of quantum mechanics, Slothrop becomes, in Joseph Slade's words, "pure transformation" ("Post-Industrial" 60).

Slothrop, after a dream in which he enacts the traditional quester's descent into the underworld (this time via a toilet in a men's room where he's lost his harmonica -- the official instrument of the Preterite), finds himself in the Zone of post-World War Two Germany on a quest for the Schwartzgerät and the scientist who conditioned him to respond sexually to the Rocket: Dr. Lazlo Jamf. Ironically, Slothrop himself has become the object of a quest: "They" are after him in order to disprove or terminate his threat to the law of cause and effect. The Zone exists as the area between one and zero, a giant observed system continually generating an infinite number of possibilities for the people who inhabit it. True to Heisenberg's Uncertainty Principle, Slothrop can never know enough about the Zone to come to a definite conclusion about his quest or exactly who it is that is after him. Eventually Slothrop, literally with all the (Tarot) cards against him, begins to scatter, to disintegrate. Ozier is the only critic who has given Slothrop's disintegration a positive reading, calling "the dissolution of Slothrop's
persona...not a diminution but part of a transformation into the timeless Being of Rilke’s angels” (197). While Pynchon refers to Rilke’s *Sonnets to Orpheus* at the moment of Slothrop’s disintegration, he is using Rilke (and especially Orpheus) as an image of transformation, not the literal end of the transformation. Slothrop goes beyond where Pynchon left Oedipa in *The Crying of Lot 49* at the moment of another intrusion of an observing system into an observed system, to become a symbol of quantum transformation itself: he scatters into particles, becoming the true embodiment of the quantum vision, transformed into an observed system and its infinite number of possibilities.

Wandering in the mountains, Slothrop not only finds the harmonica he lost but also begins to hear “harpmen and dulcimer players in all the rivers, wherever water moves” (622). Becoming a part of nature, he begins talking to rocks and trees and starts to wonder about rock consciousness. As the narrator comments, “Slothrop, just suckin’ on his harp, is closer to being a spiritual medium than he’s been yet, and he doesn’t even know it” (622).

The last we “see” of him is when he’s become “a crossroad” in the Zone, after witnessing a rainbow that symbolizes the fertility of Earth, “a stout rainbow cock driven down out of pubic clouds into Earth, green wet valleyed Earth...” (626), taking a deep breath, “not a thing in his head, just feeling natural...” (626). Having become “pure transformation,” an observed system, Slothrop only reappears when an observing system, like Seaman Bodine, makes the relationships that actualize “Slothrop” into reality. Through the transformation of
Slothrop, a "dunce and drifter" (626), the character least likely to achieve transformation, Pynchon hopes to transform the reader as well to the life-affirming vision of the quantum viewpoint.

Pynchon transfers this vision of transformation to the end of the novel, where "we" (the readers) sit, in the Orpheus Theater (another reference to this mythical image of transformation), in darkness, with the falling Rocket having reached "the last delta-t" above the roof of the theater. This is Pynchon's metaphor for our contemporary situation -- mistaking the film on the screen for reality in the same fashion as the occupants of Plato's allegorical cave, with the threat of nuclear destruction inches over our heads. However, the last delta-t is a positive image because it is a mathematical fiction. There is no such thing as the last delta-t -- delta-t is a non-zero quantity. While the distance between points becomes smaller and smaller (measured as delta-t) delta-t can never reach zero. For Pynchon, "the last delta-t" is a moment of transcendence, a moment of timelessness, when linear time is transformed into an eternal moment where time falls away, symbolized by the calculus image of the double integral. This moment is the intrusion of one world into another, the same moment Pynchon left us with at the end of *The Crying of Lot 49*. In *Gravity's Rainbow*, the narrator gives a scientific explanation for this possibility:

> But in the dynamic space of the living Rocket, the double integral has a different meaning. To integrate here is to operate on a rate of change so that
time falls away: change is stilled..."Meters per second" will integrate to "meters." The moving vehicle is frozen, in space, to become architecture, and timeless. It was never launched. It will never fall. (301)

The rocket becomes frozen in eternal time, the moment of one world's intrusion into another, the observed and observing systems meeting. Pynchon's conclusion to *Gravity's Rainbow* is not ambiguous, nor does it point toward, among a multitude of other possibilities suggested by critics, a coming apocalypse. Earlier the narrator had cautioned:

Don't jump at an infinite number of possible shapes. There is only one. It is most likely an interface between one order of things and another. (302)

The last "shape" on the movie screen is "a closeup of the face, a face we all know" (760) -- no doubt Slothrop, the image of "pure transformation," appearing at this moment of transformation, this "interface between one order of things and another" in the "Orpheus" theater. Through the transformation of Newtonian physics into quantum mechanics, he has become our modern Orpheus.
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