University of Alberta

Energized By Inefficient Machines: Geometry, *Epistemes* and Cybernetics

by

Wayne DeFehr ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Department of English

Edmonton, Alberta

Spring 2003

Your file Votre référence
ISBN: 0-612-82093-9
Our file Notre référence
ISBN: 0-612-82093-9

University of Alberta

Library Release Form

Name of Author: Wayne DeFehr

Title of Thesis: Energized by Inefficient Machines: Geometry, *Epistemes* and Cybernetics.

Degree: Doctor of Philosophy

Year this Degree Granted: 2003

10835 65 Avenue
Edmonton, AB
T6H 1V8

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Energized by Inefficient Machines: Geometry, Epistemes and Cybernetics*, submitted by Wayne DeFehr in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Dr. Paul Hjartarson, Co-Supervisor

Dr. Michael O'Driscoll, Co-Supervisor

Dr. Jo-Ann Wallace

Dr. William Beard

Dr. Stephen Scobie

January 24, 2003

Energized by Inefficient Machines:
Geometry, *Epistemes* and Cybernetics

Abstract

Historically, innovations in the disciplines of geometry and epistemology have been mutually influential, despite the fact that the spheres of numbers and words seem to exclude each other. This dissertation argues for the strength of this connection, however, by tracing the role Euclid's rational method plays in the work of several Western philosophers, as well as by showing the attempts of philosophers to increase the rigour of Euclid's method. The dissertation pursues this argument into the postmodern philosophies of Michel Foucault and Jacques Derrida, where geometry and epistemology continue this fertile relationship despite the non-metaphysical milieu.

Indeed, this study contends that some rapprochement between Derrida and Foucault might be made through the geometric concepts they deploy, even though Derridean deconstruction operates through a more general economic model than does Foucauldian historicism. Linking Derrida's mechanism of Undecidability to Foucault's concept of the *episteme* might offer a way to ameliorate the bleak determinism that has often been ascribed to Foucault's theories. The discussion then begins a deconstructive reading of a late-twentieth century *episteme*, that of posthumanism, especially as conceived by Kathryn Hayles. The dissertation argues that despite the vigour of posthumanist theories of technological union, other approaches to this same question resist the metaphysical implications of a new, whole entity formed from the merger of bodies and machines. Several narratives representing alternative points of view are juxtaposed with posthumanist theory in order to deconstruct this apparent union. Instead of depicting a simplistic merger,

some narratives in genres such as cyberpunk portray machines and bodies as not fusing permanently but in fact remaining undecidably distinct.

The dissertation concludes with readings of Ridley Scott's *Blade Runner* (1982) and Terry Gilliam's *Brazil* (1985) that challenge the posthumanist ideal of a body/machine merger by drawing on the geometric mechanism of Undecidability as it operates in Derridean deconstruction. In these narratives, cyborg figures undecidably retain elements of both the biological and the machinic. In *Blade Runner* technology does not merge with biology, but instead 'evolves' beyond it, enabling the "replicants" to become "more human than human." In *Brazil*, the categories of biology and technology both benefit from the 'productive' waste of government operations. Although almost certainly directors Ridley Scott and Terry Gilliam were not familiar with Derrida's model of deconstruction and its geometric inflection this dissertation argues, against Kathryn Hayles's posthumanism, that their technologized environments do not run with maximum efficiency, but dissipate energy paradoxically in order to operate at optimal levels.

Acknowledgements

Thank you, first, to Paul Hjartarson for his intelligence and wisdom in guiding this dissertation through its many stages. Sending me back to the drawing board untangled and straightened the several lines of this argument. Michael O'Driscoll and Jo-Ann Wallace provided pointed comments and constructive feedback for which I am grateful. I would like to thank Stephen Scobie and William Beard for their close readings and provocative questions. Through many conversations, the generosity and scholarship of Melissa Jacques and Michael Lahey has streamlined this reading machine. Mathematician Claude Lemieux's early feedback was encouraging, and kept the geometry in this dissertation close to the numbers. I am indebted to Kim Brown for her organizational gifts and efficiency. Thank you to Gary Kelly and Kris Calhoun for making departmental support available for learning the web software. The technical support provided by Taswar Bhatti and Curtis Patterson re-defines the terms "infinite" and "patience" in ways that Euclid could not have imagined. The proof is in the website. For the beautiful variety of ways they offer encouragement for intellectual work I would like to thank Jadwiga and Olgierd, as well as Dad and Myrna. Special thanks to Magda for the smart critiques and the immeasurable support she has offered throughout this process. This one's for you . . .

Energized by Inefficient Machines:
Geometry, *Epistemes* and Cybernetics

Table of Contents

Preface 1

Introduction
Preliminary Connections:
Philosophy of Geometry and Postmodern Epistemology 10

Chapter One
A Genealogy of Geometry and Epistemology 24
1.) Reasoning about Timeless Forms 30
2.) Syllogisms and Reasoned Experience 32
3.) Standardizing the Rational Tradition 36
4.) Epistemology as Pure Reason 49
5.) Tracing Geometry's Roots I 56
6.) Tracing Geometry's Roots II 59
7.) Synthesizing Reason and Experience 69
8.) Leaving Euclidean Space 83
9.) Undecidability in Geometric Reasoning 101
10.) Deconstruction and Geometry 108

Chapter Two 129
Godelian Undecidability and the Word:
Deconstructing an *Episteme*

Chapter Three 149
Godelian Undecidability and the Word:
Deconstructing a Posthuman *Episteme*

Chapter Four
Reading the Posthuman *Episteme*
in Ridley Scott's *Blade Runner* 163

Chapter Five
Reading the Posthuman *Episteme* 186
in Terry Gilliam's *Brazil*

Drawing Conclusions 219

Notes 221

Works Cited 267

Preface

Technology has been one of the most persistent themes 'after deconstruction' and on the postmodern and postmodernist scene in general, or after postmodernism.
(Plotnitsky *Reconfigurations* 314)

(For an online version of this dissertation, please visit the following site: http://www.arts.ualberta.ca/softgrids)

The considerable amount of knowledgeable writing about the relation of technology and Western culture invites further scholarship on the topic. Yet much of this prolific commentary continues to flow in one direction, offering formulaic pronouncements about technology's harmful or beneficial effects on society. In this dissertation I will focus instead on technology as dynamic, performing operations with various degrees of efficiency. Following a theoretical section in which I will outline the significance of geometry to my project as both a philosophical model and technological language, I will examine the representations of technology in two important cyberpunk films from the 1980s, Ridley Scott's *Blade Runner* (1982) and Terry Gilliam's *Brazil* (1985). I will contend that the inefficiency of the mechanistic constructs in these narratives paradoxically enables the constructs to operate at optimum levels of productivity. Contrary to popular readings of these films, the technologies abstracted into the governing structures do not transform into shiny, well-oiled bureaucratic machines. I will argue that these technocracies operate inefficiently, 'failing' intentionally to absorb their subjects. This operational weakness paradoxically permits the government to operate at its highest standard.

My investigation into the concept of productively inefficient mechanisms is partly influenced by my involvement in sound design and music composition using computers as instruments and processors. As had been taught early in Western culture, the sounds, voicings and harmonic progressions of music are fundamentally numerical, as shown in the *quadrivium* of early education programs including geometry, arithmetic, astronomy and music. When computers are factored into the equation, the influence of numbers becomes greater still. Yet often the numeric roots of music are not a part of our conscious musical enjoyment, an experience that is more deeply emotional than the coldly rational realm of numbers would at first seem to permit. As the seventeenth century mathematician Wilhelm Leibniz – whose work influenced J. S. Bach – writes, "[m]usic is a secret exercise in arithmetic of the soul, unaware of its act of counting" (in Cavanaugh). My interest in mechanism also derives from my early enjoyment of mathematics, when I was taught by mathematician Vern Braun, who spoke "algebraic" as fluently as English and German. Sometimes he could not put the operations of the formulas into words, and we were obliged to accept the grammar of numbers and mathematical signs. A further personal influence on this study comes from growing up in a conservative religious town. Given the life and death stakes of theological questions, the boundaries of what could and could not be discussed were clear, giving otherwise ponderous questions a forbidden, tantalizing air. Though we did not know the terms then, in preliminary ways we sometimes touched on issues of epistemology, teleology and ontology simply out of curiosity. In a similar spirit I explore the variety of ways that philosophers take up the question of mechanism, laying the groundwork for further connections between geometry, epistemology and cybernetics.

Definitions of the term 'mechanism' seem to support the assertions of posthumanist writer Kathryn Hayles, who contends that the merger of humans and machines is inevitable. For example, philosopher Anthony Quinn defines 'mechanism' as

> [t]he theory that all causation is, in Aristotle's terminology, efficient, i.e. that for an event to be caused is for its occurrence to be

> deducible from the antecedent condition in which it occurs, together with the relevant universal laws of nature. The traditional opponent of mechanism is teleology, the view that some, perhaps all, events must be explained in terms of the purposes which they serve, and thus that the present is determined by the future rather than by the past. (Quinn 379)

As the scope of Quinn's definition suggests, the concept of mechanism could describe not only the parts of a machine, but also any abstract process that can be broken into its components. In this broader sense, 'mechanism' could describe the relation of events that are only comprised of human interactions, without any mediating technologies. Thus, 'mechanism' can also describe the process of attempting to place knowledge on a firm footing, as philosophers had attempted for many years through Euclidean geometry.

The broad concrete and abstract application of 'mechanism' indicates its suitability as a metaphor to describe how biological entities operate as well. Kinesiology, for example, studies an athlete's movements in sport as mechanisms, reducing the arc of motion to only those fundamental components that are necessary to maximize efficiency. In the movements of the mind, likewise, theories of logic as set out in geometry attempt to establish an irrefutable proof with only the fundamental steps, considering anything more than this to be inelegant. Such application of 'mechanism' to human operations shows that the categories of biology and of technology are already often considered essentially similar. This similarity leads to provocative questions into the definition of intelligence whether, for example, machines that are constructed with austere logical programs can themselves exercise a primitive level of logic. Ontological questions regarding humans as machines, and thus determined, have been addressed already by seventeenth-century philosophers such as René Descartes, Julien La Mettrie and Wilhelm Leibniz and extend beyond the scope of this dissertation. However, I shall argue that the inefficiency of physical mechanisms precludes the synthesis of bodies and machines, but also 'productively' characterizes abstract theoretical machines, as Jacques Derrida contends. By considering *écriture* as technology, he contends that the machine offers an intentionally 'ineffective' metaphor that breaks with, and re-connects to, the metaphysics of traditional philosophy.

For centuries, the apotheosis of epistemological foundations was believed to be described in Euclid's geometry text, the *Elements*. Euclid's formal language in establishing a geometric proof exemplified the logical process at its most stringent. His logical process was dependable for human inquiry because it mechanistically excluded all steps that could not be defended with the rational faculty alone. Those especially human qualities, such as emotions, dreams and intuitions, were excluded from the proof-making process because they could not be defended with the use of reason alone. Since the language of geometry was thought to represent only the essential elements of logic necessary to construct a proof, it offers an early example of a formal language. According to the *Oxford Companion to Philosophy*,

> A formal language is a language two of whose features are formally specified: the linguistic symbols of the language and rules for joining together or concatenating these symbols into well-formed formulae or words which can be assigned precise meanings. In standard first-order logic the formal language consists of variables, constants, logical connectives, function and relational symbols, parentheses, and quantifiers, together with rules for the construction of well-formed formulae. Kurt Gödel discovered a method for assigning natural numbers to the well-formed formulae of standard first-order

> theory, and this discovery provided the basis for the proof of his famous incompleteness theorem. The development of formal languages for computer programs in the 1950s was inspired by the established formal languages used by logicians. (*Oxford Companion to Philosophy*)

Before showing that the formal language of geometry precludes the merger of machines and bodies in two narratives, I argue for the significance of geometric language in the development of several overlapping fields: of language, of logic and of epistemology. This sketch does not provide an exhaustive analysis of the relation between geometry and epistemology in the history of continental philosophy; instead, the brief discussions of origins (Plato, Aristotle, Thales, Euclid), rationalism (Descartes, Leibniz), phenomenology (Kant) and non-Euclidean geometry (Russell, Hilbert, Brouwer, Gödel) serve as a genealogy of this relation, a genealogy also providing points of analysis of postmodern concepts of epistemology advanced by Derrida and Michel Foucault. Derrida's and Foucault's engagement with many of these figures from the canon of philosophy lends support to Foucault's model of history as an archaeological dig instead of as a continuum.

I have organized this dissertation about the (inefficient) relation between geometric proofs, epistemology and machines in a series of logical steps, while at the same time attempting to reduce the influence of a linear model. Thus the dissertation introduces these themes by showing briefly the ways that postmodern philosophers Gilles Deleuze, Derrida and Foucault engaged with geometric concepts. All three employ geometric models to counter the metaphysics of organic wholeness that had characterized traditional philosophical approaches. Deleuze's multiplicity, Derrida's deconstruction and Foucault's *episteme* all draw broadly on the lexicon and ideas of geometry to shape their conceptions. However, only Derrida's writings on *écriture* as technology explicitly take up geometry, particularly that of Kurt Gödel, to illustrate how epistemological mechanisms do not conserve energy but inefficiently expend it. These postmodern philosophers' attempts to dismantle the model of epistemological foundations through geometry contrast the approaches of traditional philosophers who saw in Euclidean geometry the possibility of building their own concepts on this epistemological bedrock. Chapter One will narrate some of the historical moments, leading to the nineteenth and early twentieth centuries, that contributed to the undermining of the foundational status that had been granted Euclidean geometry.

Chapter Two takes up in greater detail Derrida's and Foucault's involvement with questions of mechanism and geometric language. Although many scholars have discussed the differences that separate their work, with Derrida focusing more closely on language and Foucault on history, several have also suggested that their work might be linked in provocative ways. Theorists such as Rudy Visker, Stephen Watson and Simon During argue that Foucault's early work on language writers such as Antonin Artaud and Derrida's later work involving Marxism offer the possibility of constructing a tentative rapprochement between them. At least two purposes may be served by this attempt at rapprochement. First, Derrida's deconstruction has been criticized for its focus on language to the exclusion of political engagement. Linking some features of deconstruction with a historicist approach may provide a mechanism for political interventions that address this question. Second, Foucauldian historicism has been criticized for its determinist tenor. In his attempt to dismantle the liberal humanist figure, Foucault's model of history admits a certain amount of involuntarism. According to Foucault the epistemic shifts that shape the movement of history take place apart from human agency. Although Foucauldian historicism attempts to reduce the Cartesian project of a single history marching to greater heights of scientific progress with a pluralistic model, Foucault presents each historical *epoch* -- especially in *The Order of Things* – as apparent totalities that change without human intervention. In this dissertation I argue that the Foucauldian *episteme* that organizes the knowledge of a historical epoch can be inflected so that it functions like the mechanism of Godelian Undecidability. In this way Foucault's historicist project would resemble Derridean deconstruction in that both would draw on this same mechanism, reducing the determinist and totalizing tenor of Foucault's historicism. I will argue that this undecidable mechanism operates in certain places of Foucault's work, notably in his introduction to *The Order of Things*. In that Introduction Foucault states that the themes of representation that occupy the book

> first arose out of a passage in Borges, out of the laughter that shattered, as I read the passage, all the familiar landmarks of my thought . . . breaking up all the ordered surfaces and all the planes with which we are accustomed to tame the wild profusion of existing things. (Foucault OT xv)

Self-referentiality in Borges' list of objects proscribes one of the boundaries of reason, just as this paradox had done in geometry for Gödel and in language for Derrida.

After laying the initial groundwork of a rapprochement between Derrida and Foucault in Chapter Three, I apply to Foucault's historicist concept of the *episteme* the mechanism of undecidability on which Derrida draws for his theory of deconstruction. The discussion considers the posthumanist movement as articulated notably by Kathryn Hayles to exemplify a late twentieth-century *episteme* that celebrates the fusion of humans and machines. I argue, however, that despite the vigor of posthumanist theories of technological union, several narratives at this same historical moment depict the human relation with technology in more complicated ways. Drawing on the concept of the productively inefficient mechanism, I will argue that certain narrative genres, such as cyberpunk, portray bodies and machines as resisting full synthesis but remaining undecidably distinct.

Chapters Four and Five of the dissertation read Ridley Scott's *Blade Runner* and Terry Gilliam's *Brazil* as important popular culture texts that portray the intentional 'failure' of mechanisms that would link biology with technology. These readings of SF narratives approach these films by drawing on the earlier theoretical discussion of geometry. As an application of the theory, the reading often serves to test and to validate the theoretical contentions and insights that were drawn from the earlier section. The readings may then be said to perform an efficient operation, demonstrating the success of the theoretical constructs to the degree that they can explain the narrative. Modifying this binary model somewhat, I intend the theoretical section to register as a reading or a construction of a geometric model just as the textual interpretation section registers as a theoretical or tentative application of this theory.

The section that takes up *Blade Runner*, for example, attempts to deploy deconstruction techniques as a 'machine' in order to show the mechanism behind the termination of high-tech replicants like Roy Baty and Priss. Instead of achieving an organic synthesis with the human realm, these cyborgs have 'evolved' to become more human than the humans, as the Tyrell Corporation motto states. The concept of mechanism has begun to work so well here that synthetics like Baty and Priss express an unexpectedly wide range of the non-rational, including disorderly feelings of love, grief and anger. The humans, on the other hand, function mechanically, failing to show emotion of any depth. In *Blade Runner* the humans and machines are not on converging paths, but on parallel lines that remain distinct at infinity. A similar mechanism enforces the separation of bodies and machines in *Brazil.* One might view Sam Lowry's and Jill Layton's arrests at the end of the narrative as demonstrating the punitive effects of a highly evolved disciplinary machine in a simple love story. Unlike Foucault's conception of the Panopticon as a perfectly efficient technology, however, the regime's mechanisms have become gummed up with the dirt of biology, with the inefficiency of the humans who operate these mechanisms. Instead of 'evolving' into a cybernetic organism that is super-human, the technocracy in *Brazil* remains as human as the humans, to modify Tyrell's motto. After much inefficient bureaucratic bungling, the authorities lobotomize Lowry for his several inefficiencies. Ironically, the lobotomy would make him the perfect public servant in *Brazil's* environment, but this government has probably already replaced him with another functionary.

Introduction

Preliminary Connections: Philosophy of Geometry and Postmodern Epistemology

In the postmodern context, mathematical philosophy influences the conception of epistemological and formal issues. Instead of serving to stabilize and organize meaning and practice as we might expect,[1] based on its repertoire of logically structured paradigms, the philosophy of mathematics in the postmodern context accentuates the fluidity of epistemological models, their historic contingency, and the aporias in their structures. Thus we can note the influence of mathematical philosophy on the work of prominent postmodern thinkers such as Gilles Deleuze,[2] Jacques Derrida, and Michel Foucault, particularly as their discussions broach the topic of epistemology. For example, three of Gilles Deleuze's texts -- *The Logic of Sense, The Fold: Leibniz and the Baroque,* and *Expressionism in Philosophy: Spinoza* – debate and draw upon philosophers who were also mathematicians. *The Logic of Sense* begins with an extended study of the Victorian mathematician Lewis Carroll, whose work contains, among other things, "an exemplary logical and linguistic formalism" (Deleuze *LS* xiii). Deleuze presents a "series of paradoxes" that form the bases of his reading of sense's intermingling with nonsense in the work of Carroll and the stoicists. By contrast, *The Fold* focuses more specifically on the work of a single philosopher, Wilhelm Leibniz. Through the malleable geometric figure of the fold, Deleuze reads Leibniz's thought against "atomic theory, differential calculus, classical and contemporary painting and music, and . . . the history of logic" (Deleuze *TF* xi). Deleuze in *The Fold* finds in Leibniz's "idea of families of curves . . . a series of curves that not only imply constant parameters for each and every curve, but the reduction of variables to a 'single and unique variability' of the touching or tangent curve: the fold" (Deleuze *TF* 18-19). Accordingly, for Deleuze, Leibniz's fold initiates a new geometric object characterized not by staticity or fixity, but by "continuous movement," "fluctuation," and "modulation" (Deleuze *TF* 19). As well, Deleuze's study of Spinoza's expressionism also draws on a philosophy of mathematics. In his introduction to this work he writes:

> In Spinoza's thought, life is not an idea, a matter of theory. It is a way of being. It is only from this perspective that his geometrical method is fully comprehensible. In the *Ethics*, it is opposition to everything that takes pleasure in the powerlessness and distress of men, everything that feeds on accusations, on malice, on belittlement, on low interpretations . . . (Deleuze *EPS* 322)

According to Deleuze, one of the objections to Spinoza's geometric method (that it is "less than fully comprehensible" [*EPS* 20]) is advanced by Hegel. Hegel objects to Spinoza's method because it does not account for the organic movement that he believes is necessary for someone to approach the *Aufhebung* or "Absolute." In Hegel's conception, the *Aufhebung* names the final fullness of being, the teleology, toward which all history is proceeding. Deleuze describes Hegel's position:

> Consider for example the proof that the sum of the angles of a triangle is equal to two right angles, where one begins by extending the base of the triangle. The base is hardly like some plant that grows by itself: it takes a mathematician to extend it, just as it is the mathematician who considers from a new point of view the side of the triangle to which he draws a line parallel, and so on. (Deleuze

EPS 20-21)

However, Deleuze responds on Spinoza's behalf by arguing that his geometric objects satisfy Hegel's complaint, because they express an "infinite collective being," so that "no problem is posed by the application of geometrical method to the Absolute" (Deleuze *EPS* 22). Instead of failing to account for an organic movement toward the *Aufhebung*, Deleuze argues, Spinoza's geometric methodology allows for an expression of the *Aufhebung* that is already ongoing.

A philosophy of mathematics plays an influential role in Deleuze's later work with Guattari on the relation of epistemology to space and power. *A Thousand Plateaus: Capitalism and Schizophrenia* draws its organizing schema from the field of geometry, with its vocabulary of points, lines, rhizomes, plains, striated and smooth spaces. Instead of sketching their models of epistemology and form with a vertical structure, signified in the tree, they sketch their models with a horizontal structure, represented by the surface root system of that tree, the rhizome (Deleuze and Guattari 18). Like Deleuze's earlier readings with geometric philosophy, *A Thousand Plateaus* uses geometry to describe not a static Platonic model of unchanging idealized objects existing in some noumenal sphere, but the fluid-like structures that channel various flows across regulated planes. "[T]he flow of matter-energy, the flow of population, the flow of food, and the urban flow" are constant concerns for "representatives of the world economy, or of the axiomatic" (Deleuze and Guattari 468). The significance of geometry in Deleuze and Guattari's conception of the movement of energies across the earth surfaces again in their discussion of the work of another philosopher-mathematician, Edmund Husserl. In this context, Deleuze and Guattari outline the distinctions between what they term "royal" and "nomad" science. Philosophy of geometry serves to elucidate questions of epistemology. In their model, "royal" science receives state sanction. Its goals include the maintenance of stability and staticity. Nomad science for Deleuze and Guattari, on the other hand, is fluid, moving across its field of knowledge with "transformations, distortions, ablations, and augmentations" (Deleuze and Guattari 367). Thus Husserl, they say, "speaks of a protogeometry that addresses vague, in other words, vagabond or nomadic, morphological essences" (Deleuze and Guattari 367). However, they also argue that Husserl fails to understand that these early, vague models of geometry do not progress toward some condition as exemplars of royal science. Husserl's description of mathematical history as a series of advancements shows the grounds for their critique. In *The Origin of Geometry* Husserl writes:

> We understand our geometry, available to us through tradition (we have learned it, and so have our teachers), to be a total acquisition of spiritual accomplishments which grows through the continued work of new spiritual acts into new acquisitions. We know of its handed-down, earlier forms, as those from which it has arisen; but with every form the reference to an earlier one is repeated. Clearly, then, geometry must have arisen out of a first acquisition, out of first creative activities. We understand its persisting manner of being: it is not only a mobile forward process from one set of acquisitions to another but a continuous synthesis in which all acquisitions maintain their validity, all make up a totality such that, at every present stage, the total acquisition is, so to speak, the total premise for the acquisitions of the new level. Geometry necessarily has this mobility and has a horizon of geometrical future in precisely this style; this is

> its meaning for every geometer who has the consciousness . . . of existing within a forward development understood as the progress of knowledge being built into the horizon. The same thing is true of every science. (Husserl 159)

Although Deleuze and Guattari support Husserl's idea of a "protogeometry" that gradually emerges as vague essences, they do not accept his related model of progression and completion at every evolutionary stage. Instead, for them Husserl's "anexact yet rigorous" geometry exemplifies a kind of science that contrasts with the striated model of royal science.

> What we have . . . are two formally different conceptions of science, and, ontologically, a single field of interaction in which royal science continually appropriates the contents of . . . nomad science while nomad science continually cuts the contents of royal science loose. (Deleuze and Guattari 367)

Where Husserl inserts his concept of nomad science, however, into an efficient linear model, Deleuze and Guattari distance themselves from his work.

Like Deleuze, Jacques Derrida engages with the geometric framework that buttresses Husserl's phenomenology. Unlike Deleuze, Derrida's deconstructive program attempts to find the *aporias*, instead of the flows, in the "mobile forward process" of the Husserlian model. Thus Plotnitsky states that the "most important treatment of the question of mathematics is [Derrida's] analysis of Husserl" in the text we have been discussing here (Plotnitsky *C* 62). In his "treatment of the question of mathematics," then, Derrida also focuses on Husserl's conception of the way new concepts emerge in geometry. Although, as Plotnitsky states, for Husserl "the origin of geometry is not geometry; it is philosophy in the general sense of that which thinks on the essentiality of essences" (Plotnitsky *C* 62-63), Derrida shows that this statement is ultimately untenable within Husserlian phenomenology itself, by comparing Husserl's theory of geometric origins with Kant's: "In a historical retrospection towards origins, Kant also evokes this mutation or transformation (*Umanderung*), this "*revolution*" which gave birth to mathematics . . ." (Derrida *EH* 39). Both Kant and Husserl are "attentive to the historical dimension of *a priori* possibilities," but what sets them apart, according to Derrida, is Kant's indifference to "factual origins" (Derrida *EH* 39). In Kant's view, geometry is a "revelation" for the first geometer, and is not produced by him. The geometer receives this "happy thought" as an "empirical unfolding of a profound reception" (Derrida *EH* 40). In Husserl, on the other hand, the first geometer (a distinction attributed to Thales) creates the first geometric patterns. "[T]he objects or objectivities that it intends did *not* exist *before* it; and this "*before*" of the ideal objectivity marks more than the chronological eve of a fact: it marks a transcendental prehistory" (Derrida *EH* 40). For Derrida this distinction is crucial.

While conceding the idealism in Kant's approach to geometric origins ("it is an ideal history" [Derrida *EH* 41]), Derrida asserts that the distinction that permits Kant's formulation more possibility than Husserl's is the fact that the geometric origin in Kant is an "operation," instead of a "founding."

> This operation unfolds explicative gestures in the space of a possibility already open to the geometer . . . Thus the spontaneous eidetic reduction which frees the geometrical essence from all empirical reality — that of sensible figuration as well as from the geometer's psychological lived experience — is for Kant always already done. (Derrida *EH* 41)

By contrast, Husserl's geometer uses his intuition to create the ideal objects of mathematics in an act that is "absolutely constitutive" (Derrida *EH* 40). Upon this intuitive creative act Husserl constructs the ideal, transcendental formations that organize the subjects' engagement with the life-world. Derrida's distinction between a realm in process and a realm being established in the geometry of Kant and Husserl is further clarified in the translator's note at the bottom of the page:

> Among all the translations already proposed for the notion of *Leistung* . . . the word "production" seemed to overlay most properly all the significations that Husserl recognizes in this act that he also designates by some complementary notions: *pro-duction*, which leads to the light, constitutes the "over against us" of objectivity; but this bringing to light is also, like all production (*Erzeugung*) in general, a creation (*Schopfung*) and an act of formation (*Bildung, Gestaltung*), from which comes ideal objectivity as *Gebilde, Gestalt, Erzeugnis*, and so on. (f.n. 27 in Derrida *EH* 40)

Derrida thus finds that his deconstructive technique can perform in Husserl's *Origin* because of the aporia between its anthropological foundations and its geometric, transcendental aspirations.

Although *Introduction to the Origin of Geometry* is Derrida's first major publication (1962), the objects and vocabulary of geometry continue to inform his later work as well. For Plotnitsky, the influence of geometry on Derrida's work derives in part from its status as a non-phonetic language system:[3] "Derrida relates the question of *writing* to the question of mathematics as language from the outset of *Of Grammatology*. Mathematical symbolism offers an example of nonphonetic writing, and the possibility of such a writing helps to undermine the metaphysics of presence" (Plotnitsky *C* 62). Still, despite their positive aspect as unspoken, and therefore, anti-metaphysical objects, Derrida does attack geometric symbols in *Of Grammatology* where they begin to serve as metaphors for a metaphysics of presence. Later this paper will consider the ways in which Derrida draws on geometric models to help him explicate an *anti*-epistemology. For now, though, we notice that he connects the line, an object from a geometric repertoire, with an ontology of writing and of speech, a "linearism [that] is undoubtedly inseparable from phonologism" (Derrida *EH* 44). For Derrida, the auditory mode would not necessarily have to announce the metaphysical presence implied in voice. To illustrate, he cites Roman Jakobson's alternative to a linear auditory model, that of the "chord in music" (Derrida *EH* 44). Derrida then juxtaposes Jakobson's non-linear, vertical chordal model, with Ferdinand de Saussure's linear, horizontal model. For de Saussure, the auditory exemplifies the features of a voice that speaks, one word after another, in time. The "Jakobsonian critique of Saussure's linearist concept" helps expose linearity "only as a particular model, whatever might be its privilege" (Derrida *EH* 50). Derrida asserts that the prioritizing of the linear model of writing (in concepts of continuity, succession, organicity, teleology) has been

> structurally bound up with that of economy, of technics, and of ideology. This solidarity appears in the process of thesaurization, capitalization, sedentarization, hierarchization, of the formation of ideology by the class that writes or rather commands the scribes. (Derrida *EH* 50)

Thus, Derrida argues that deconstruction also has a political agenda that extends beyond the uses of language.

By contrast, Foucault's engagement with a philosophy of mathematics is not as sustained nor as detailed as that of Deleuze nor Derrida. He shows that he is aware of the developments in a philosophy of mathematics in his early works but does not directly pursue their implications for his own structuring of history. In *The Order of Things*, for example, a study of the "taxonomies" and "epistemological figures" that form the discursive patterns of historical epochs, he mentions the epistemological figure of mathematical formalism only once, and that near the close of the book. His statement about mathematical formalism surfaces in the context of a discussion about the properties of language that structure knowledge in the human sciences. He writes:

> On the one hand, suddenly very near to all these empirical domains, questions arise which before had seemed very distant from them: these questions concern a general formalization of thought and knowledge; and at a time when they were still thought to be dedicated solely to the relation between logic and mathematics, they suddenly open up the possibility, and the task, of purifying the old empirical reason by constituting formal languages, and of applying a second critique of pure reason on the basis of new forms of the mathematical *a priori*. (Foucault OT 383)

While Deleuze draws on geometry to exemplify conceptual fluxes and flows and Derrida draws on geometry to demonstrate the *aporias* in transcendental philosophy, Foucault, instead, finds in formal mathematical language a tendency to turn back to old empirical practices. The desire for this return to empiricism derives from the apparent possibility of a more rigorous, stringent formal language. This historical *episteme* entices some thinkers back to earlier modes of expression, represented for Foucault in mathematical formalism. At the same time, however, another *episteme* draws others in another direction, showing ultimately that these conservative linguistic moves are untenable. Foucault finds the experiments conducted against form by language poets such as Artaud and Roussel to exemplify the pressure exerted against mathematical formalism across cultural formations (Foucault OT 383).

In his next book, *The Archaeology of Knowledge* (1971), Foucault again refers to a philosophy of mathematics, but this time, instead of describing mathematics as a language with unexamined humanist values, he describes it as a form of knowledge that continuously crosses thresholds of crystalization. According to Foucault, this process remains outside the field of mathematical study itself, however. Instead, mathematics tends to inscribe new inductive methods into a progressive model, simultaneously showing that previous methods were merely intermediate stages leading to the present practice. Foucault's reading of mathematical practice as linear and progressive here echoes Deleuze and Guattari's critique of Husserlian "protogeometry." Foucault writes that analysis at the level of formalization

> is this history that mathematics never ceases to recount about itself in the process of its own development. What it possesses at a given moment (its domain, its methods, the objects that it defines, the language that it employs) is never thrown back into the external field of non-scientificity, but is constantly undergoing redefinition . . . in the formal structure that mathematics constitutes . . . (Foucault *AK* 189)

Like both Deleuze and Derrida, Foucault objects to the claims to organicity and wholeness that are implicit in mathematics' progressive historical account of itself. Although *The Archaeology of Knowledge* acknowledges that "[m]athematics has certainly served as a model for most scientific discourses in their efforts to attain formal rigor and demonstrativity" (Foucault *AK* 189), Foucault finds its further claim to a transcendent, a-historic march of progress that serves as a "prototype for the birth and development of all the other sciences" to be a "bad example, an example at least from which one cannot generalize" (Foucault *AK* 189). At risk in this linear, upwardly-angled model is the possibility of "homogenizing all the unique forms of historicity, of reducing to the authority of a single rupture all the different thresholds that a discursive practice may cross, and reproduce endlessly, at every moment in time, the problem of origin . . ." (Foucault *AK 189*).

Foucault's concepts of history and discursive formation evolve without turning directly to a philosophy of mathematics for explication. However, much of his work is framed by the similar concerns and issues that organize the search in mathematical philosophy for epistemological foundations or for a sound methodology, despite Foucault's overt dismissal of the practice of mathematics in *The Order of Things* and *The Archaeology of Knowledge*. Stephen Watson also notes how Foucault draws on a philosophy of mathematics to support his post-structuralist thought, despite his disavowal of its validity. Watson opens his essay, "'Between Tradition and Oblivion': Foucault, the Complications of Form, the Literatures of Reason, and the Esthetics of Existence" with Foucault's acknowledgement of the pervasive influence of formalism across many disciplines: "[i]n a 1983 interview Michel Foucault characterized his work by connecting it with the complicated status of formalism in twentieth century thought, claiming that the latter marked 'one of the most powerful and complex forces in twentieth century

Europe'" (Watson 262). Watson continues by describing Foucault's work as "complicit" with this formalism despite his "notorious denial of the subject for the sake of . . . authorial anonymity" (Watson 262). Noting Foucault's reference to mathematical formalism in *The Order of Things* (384), Watson states that Foucault's project "not only identified him with 'revolutionaries' of aesthetic modernism like Mallarmé or Roussel but also with the discoveries of [the Parisian formalist mathematical group] Bourbaki" (Watson 262). Furthermore, Watson links the philosopher of science Jean Cavailles' "treatise on the foundations of mathematics" to the "order of reasons" offered in *The Order of Things* for the failure of Renaissance hermeneutics. As is reflected in Foucault's text, the insufficient "narrative allegory," together with the self-reflexive "formal tautology" that was irreducible for Cavailles in mathematics, cannot account for the "infinity of Being" toward which language moves for Renaissance thinkers (Watson 269).

The case for the influence of mathematics on Foucault's post-structuralist and post-phenomenological work is further strengthened by Deleuze's approach to the Foucauldian text. In "A New Archivist" (in *Foucault*), Deleuze investigates several issues that Foucault raises in *The Archaeology of Knowledge*. The chapter opens accordingly with descriptions of "three different realms of space which encircle any statement" (Deleuze *F* 4). Deleuze identifies these realms as *collateral space* ("an associate or adjacent domain formed from other statements that are part of the same group" [5]); *correlative space* ("Here we are concerned with the link which a statement entertains . . . with its subjects, objects and concepts" [6]) and *complementary space* ("non-discursive formations, 'instructions, political events, economic practices and processes'" [9]).

Deleuze's discussion of these statements initially seems to echo Derrida's concept of “differance.” He writes: “[i]f the repetition of statements is subject to such strict conditions, this is not by virtue of external conditions but as a result of that internal materiality that makes repetition itself the power that a statement is alone in possessing” (Deleuze *F* 11). Then Deleuze opens his focus on the independent power of statements to include their political context, linking the discursive statement (“that is to say . . . the pure transmission of unique elements which remain indeterminate points” [11]) with its “non-discursive milieux” (Deleuze *F* 10). Despite his overall support of Foucault’s historicism, Deleuze does identify the traces of a modernist metaphysics in Foucault’s description of madness as a singular experience in *Madness and Civilization* and of the emergence of a “unitary [medical] subject” in *The Birth of the Clinic* (Deleuze *F* 13).

Apart from this identification of humanist residue in Foucault’s thought, where he inadvertently implies the metaphysical unity in the human subject to which he was explicitly opposed, Deleuze finds that the rest of his theoretical space is aptly represented by the concept of “multiplicity.” Once again, the model to which Deleuze turns to demonstrate the relation between epistemology and space is derived from geometry. The nineteenth century geometer Georg Riemann creates the concept of multiplicities in his search for a replacement for the inconsistent model of Euclidean geometry. Deleuze states:

> It was Riemann in the field of physics and mathematics who dreamed up the notion of ‘multiplicity’ and different kinds of multiplicities. The philosophical importance of this notion then appeared in Husserl’s *Formal and Transcendental Logic,* and in Bergson’s *Essay on the Immediate Given of Awareness* . . . But the notion died out in these two areas, either because it became

> obscured by a newly restored simple dualism arising from a distinction made between genres, or because it tended to assume the status of an axiomatic system. (Deleuze *F* 13)

Despite the waning of the philosophical application of Riemann's "multiplicity," Deleuze finds this geometric model an apt representation of Foucault's discursive structures, because it represents the first time the term is used in a noun form. Thus Riemann's nineteenth century model has the advantage, in the context of Foucault's philosophy, of avoiding the metaphysical implications of traditional philosophical problems such as "the multiple and the one," as well as avoiding the internal contradictions of Euclid's axiomatic system. Instead, Deleuze argues, "multiplicity is . . . topological. Foucault's book represents the most decisive step yet taken in the theory-practice of multiplicities" (Deleuze *F* 14). Foucault's topology allows for pluralities to be produced and circulate without referring back to metaphysical models to ensure their validity.

My dissertation, therefore, tests the possibility of maintaining Foucault's resistance to metaphysical models while also avoiding the bleak determinism that characterizes his non-humanist, non-progressive historicism. The Undecidability Theorems of geometer Kurt Gödel, on which Derrida draws for his theory of deconstruction, open up the possibility of greater play for the *epistemic* shifts that lead from one historical epoch to another.

Chapter One
A Genealogy of Geometry and Epistemology

In this dissertation I contend that geometry's interrelation with epistemology is most clearly represented by a non-linear historical model similar to that outlined by Foucault in his essay "Nietzsche, Genealogy, History," where he proposes his non-teleological structuring of historical narrative. He begins by describing the historical approach that he challenges, characterized by the work of Paul Ree who, Foucault says, is "wrong to follow the English tendency in describing the history of morality in terms of a linear development — in reducing its entire history and genesis to an exclusive concern for utility" (Foucault *NGH* 77). For Foucault the network of connections formed by historic contingency, on the other hand, "record[s] the singularity of events outside of any monotonous finality" (Foucault *NGH* 77). Foucault bases his own non-linear model on Nietzsche's genealogical (non-)model of historical events. Nietzsche's description of history attracts Foucault because "it challenges the pursuit of the origin (*Ursprung*) [and] the attempt to capture the exact essence of things . . . . [T]his search assumes the existence of immobile forms that precede the external world of accident and succession" (Foucault *NGH* 78). Although on one level the events preceding the publication of geometer Kurt Gödel's Undecidability Theorems in 1931, on which Derrida draws to model the operation of deconstruction, might appear to follow a conventional linear historical pattern, in fact the dynamic intellectual atmosphere preceding Gödel's proofs was much more chaotic than so simple a model could describe. Though he was the first to publish a formal proof that demonstrated the logical impossibility of formal proofs, several geometers prior to Gödel had already noticed that Euclid's axiomatic method contained many inefficiencies, despite the others' claims of its logical rigour.

Perhaps the chronological simplicity of the linear model leads many historians of mathematics to describe a history of the emergence of new geometric ideas as a succession of events that build on the ones that come before, as Husserl does in *The Origins of Geometry*. For example, mathematician Richard Trudeau begins his narrative of mathematical history with the first known geometer, Thales, and then proceeds to the Pythagoreans and then to Plato. One philosopher of mathematics, Stephen Korner, opens with Plato, and then shows how much of Aristotle's philosophy reacts against Plato's metaphysics. Korner's discussion of Kant likewise begins by showing his opposition to Leibniz's rationalism. Mathematician Douglas Hofstadter, as well as historians Ernest Nagel and James R. Newman, couch their description of the emergence of Gödel's Undecidability theorems in narrative terms, where the work of nineteenth century geometers directly leads to the work of others who either build on this work or reject it. Foucault himself accepts a certain element of linearity in his historical method, but gives this linearity less influence in the movement of history than other factors, both contingent and aleatory. In the preface to *The Order of Things* he writes:

> The order on the basis of which we think today does not have the same mode of being as that of the Classical thinkers. Despite the impression we may have of an almost uninterrupted development of the European *ratio* from the Renaissance to our own day, despite our possible belief that the classifications of Linnaeus, modified to a greater or lesser degree, can still lay claim to some sort of validity, that Condillac's theory of value can be recognized to some extent in nineteenth-century marginalism, that Keynes was well aware of the affinities between his own analyses and those of Cantillon, that the language of general grammar . . . is not so very far removed from our

> own – all this quasi-continuity on the level of ideas and themes is doubtless only a surface appearance; on the archaeological level, we see that the system of positivities was transformed in a whole-sale fashion at the end of the eighteenth and beginning of the nineteenth century. Not that reason made any progress: it was simply that the mode of being of things, and of the order that divided them up before presenting them to the understanding, was profoundly altered. (Foucault *OT* xxii)

The potentially stronger links with "progress in reason," according to Foucault, are those that are forged between ideas across other disciplines. Thus, "if the natural history of Tournefort, Linnaeus, and Buffon can be related to anything at all other than itself, it is not to biology . . . but to Bauzee's general grammar, to the analysis of money and wealth as found in the works of Law" (Foucault *OT* xxiii). One such cross-disciplinary fertilization appears to take place in geometry during the nineteenth century. Mathematician Douglas Hofstadter outlines the history of this event, or "singularity," in Foucault's term:

> In 1823, non-Euclidean geometry was discovered simultaneously, in one of those inexplicable coincidences, by a Hungarian mathematician, Janos Bolyai . . . and a Russian mathematician, Nikolay Lobachevsky . . . . And ironically, in that same year, the great French mathematician Adrien-Marie Legendre came up with what he was sure was a proof of Euclid's fifth postulate, very much along the lines of Saccheri . . . . In Germany, Gauss himself and a few others had more or less independently hit upon Non-Euclidean ideas. (Hofstadter 92)

Since, according to Hofstadter, non-Euclidean geometry did not attempt to describe lived space as did Euclidean geometry, it was viewed as a mechanical way of thinking, based solely on the establishment of proofs through their internal consistency. Through a Foucauldian historical approach, these simultaneous discoveries of non-Euclidean geometries during the Victorian period could be linked with the growing interest in technology. Furthermore, the Victorian interest in technology in turn increased interest in the power of purely formal languages to direct that technology, as exemplified in the prototype of the calculator invented by Charles Babbage. Similarly, as Volker Peckhaus describes, at this same time interest was piqued by the possibility of formal languages such as Esperanto and Volapuk ("a universal language like Esperanto very popular in Germany at that time" [Peckhaus]) that would permit pan-global communication.

I present an expository history of mathematical philosophy in the pages that follow not according to chronology, but according to their specific relation to late twentieth-century issues relating cybernetics and epistemology. I argue that the singularities of this history represent exemplary moments that postmodern thinkers have addressed regarding the operation of both concrete and abstract mechanisms that I take up in detail in Chapters Two and Three. The classical philosophies of Plato, Aristotle, Pythagoras and Euclid show how the axiomatic process supported early and notable attempts at abstracting principles of reason from geometric practice. The analytic philosophies of Descartes and Leibniz add greater complexity and rigour to these early attempts at standardizing logic, and lay the groundwork for linking rationalist methodology and the functions of machines. Lastly, the phenomenological system developed by Kant attempts to synthesize the forms of reason with empirical evidence, linking the rationalist mechanism of the mind posited by Descartes and Leibniz with sensory information presented by the body. Like the philosophers before him, Kant models the processes of testing information from the mind and body after Euclid's geometric method, believing this method to provide the most austere, mechanistic links of sound reason. These philosophies presenting the complete fusion of epistemology with mechanistic Euclidean methods resemble in important ways the unguardedly optimistic 'posthuman' philosophy of the late twentieth-century in their attempts at presenting a completely efficient model of mechanicity. As I demonstrate in the critique of posthumanism in Chapter Three, and the readings of *Blade Runner* and *Brazil* in Chapters Four and Five, the inefficiency of mechanical and rational constructs that Gödel formally proves in his Undecidability Theorems undermines their operation.

One way to show the significance of geometric philosophy for conceptions of epistemology and postmodern anti-epistemology is through the reception accorded Euclid's geometry textbook, the *Elements.* According to historian B. L. van der Waerden,

> Almost from the time of its writing and lasting almost to the present, [Euclid's] *Elements* has exerted a continuous and major influence on human affairs. It was the primary source of geometric reasoning, theorems, and methods at least until the advent of non-Euclidean geometry in the nineteenth century. It is sometimes said that, next to the Bible, the *Elements* may be the most translated, published, and studied of all the books produced in the Western world. (in O'Connor and Robertson)

To underscore the significance of the *Elements* for Western culture, O'Connor and Robertson state that "More than one thousand editions of *The Elements* have been published since it was first printed in 1482" (O'Connor and Robertson). Prior to its first printing, the *Elements* went through many "editions," as it was copied, re-copied and passed around. As Trudeau points out, soon after it was first compiled by Euclid,

> the *Elements* was established as the standard introduction to geometry, and copies were much in demand. As every copy was handmade, even direct copies of the original manuscript must have differed somewhat from each other. Changes in the text could only accumulate as these copies and copies of these copies, were distributed around the Mediterranean, and were copied and recopied in their turn, and so on over the centuries. Sometimes changes were made deliberately, as when Theon of Alexandria (fourth century A. D.), displeased with the version that had come down to him after almost 700 years, clarified the language, interpolated steps in proofs, and added alternate proofs and minor theorems that were entirely his own.
>
> The first printed version of the *Elements* was descended from Theon's revision, as follows. About 400 years after Theon, a copy . . . of Theon's revision was translated into Arabic. Then, about 1120, a copy of the Arabic translation was translated into Latin by the English philosopher Adelard of Bath. Then, about 1270, Adelard's translation . . . was revised, in light of other Arabic sources (themselves derived from possibly different Greek versions of Theon's revision), by the Italian scientist Campanus of Novara. Finally, Campanus' revision . . . was printed in Venice in 1482. Though the title page said the work was Euclid's, untold alterations had been made on the roughly 1800-year voyage from Euclid's hand into print. (Trudeau 22-23)

Much of the attention that Euclid's *Elements* attracted derived not only from its application to geometry *per se*, but from the logical method that organized Euclid's collection of postulates, theorems and proofs. The rational principles on which the *Elements* were founded made it the "paradigm that scientists have been emulating ever since its appearance. It is the archetypal scientific treatise" (Trudeau 5). As with the other foundational text for Western culture, the Bible, many interpreters took up Euclid's *Elements* to support the philosophical positions they were attempting to advance.

In the history that follows I trace some of the arguments that rose out of a philosophy of geometry, noting the shifts between analytic and phenomenological positions as well as postmodern interrogations of the metaphysical assumptions that undergird their systems. This outline describes the epistemological models that are complicated by Derrida's deconstructive work, particularly through his deployment of the 'inefficient technology' of Gödel's Undecidability Theorems. These traces form the blueprints of a critical technology that tests Foucault's historicist mechanism, that of the *episteme*. I contend that by 'mechanistically' linking Derrida's deconstruction with Foucault's historicist machine, one could begin to construct a response to the bleakly determinist elements in Foucault's *episteme*, without returning to liberal humanist models of the subject imbued with a metaphysical presence.

Chapter One
1.) Reasoning about Timeless Forms

Although Platonic philosophy precedes the writing of Euclid's *Elements*, the axiomatic method of geometry was being practiced, and demonstrated for Plato the power of a rational mind thinking according to similar logical principles as governed the construction of a geometric proof. As do many philosophical histories, philosopher Stephen Korner begins his discussion of nineteenth century geometers by considering the work of Plato. The lines and circles that comprise the objects of geometry interest Plato in the *Phaedrus* because of their perfection.

Because of their condition as ideal shapes, Plato infers that they do not have their origin anywhere on earth, amongst the physical objects of time and space. Instead they occupy a noumenal sphere, a World of Forms that exists alongside the physical world. From here he further infers that geometric objects exist apart from people's ability to apprehend them.

From the Platonic point of view, the history of geometry is thus the history of discoveries made by the geometer that take place apart from his having thought of them in his own mind. This Platonic view is described by Stewart Shapiro to contrast with the structuralist approach to mathematics that he advances. Shapiro states that an "ontological platonist" is "someone who holds that ordinary physical objects and numbers are on par" (in Shapiro 72). Shapiro's structuralists instead would dismiss the independence and stability of mathematical objects. For them, "numbers exist because of their relations with other numbers" (Shapiro 72). Furthermore, for Plato, the independence of numbers means that they cannot be accessed through the senses, or empirically, but instead can only be understood through reason.

Thus in the *Gorgias* Plato distinguishes between two kinds of mathematical practice, the one dealing with "the even and the odd, with reference to how much each happens to be" (451A-C), and the other dealing with the logic that organizes their relations. According to Jacob Klein, the concept of logic in Plato "raises to an explicit science that knowledge of relations among numbers which . . . precedes, and indeed must precede, all calculation" (in Shapiro 73). In the sense that Plato views mathematical objects as *a priori*, and accessible through rational faculties alone, Platonism belongs among those approaches that are idealist and analytical. By contrast, according to Shapiro, the structuralist would reject the idea that any mathematical elements can exist in some pristine, timeless condition apart from the logic of their relations, and from human engagement. “The independence of the numbers does not exist . . .” (Shapiro 73). For the Platonist, however, mathematical forms are characterized by “precision, timelessness, and independence . . .” (Korner 15). Through his access to an earlier version of the *Elements* than the one Euclid was to write later, Plato considered geometric practice to be the “'knowledge of what eternally exists'” (in Trudeau 115).

Chapter One
2.) Syllogisms and Reasoned Experience

Aristotle's challenge to Plato’s views about the stability and timelessness of mathematical objects is based on Plato's reliance exclusively on the activities of the mind. For Aristotle, no knowledge could exist that is *a priori* as Plato had taught, but instead can only be gained through experience with one’s senses. This empirical view downgrades the epistemology of the Platonists and provides an early model for the phenomenology of Kant as well as the twentieth-century posthumanism of Kathryn Hayles, since it outlines a framework for efficiently linking epistemology, bodies and concrete machines. For Aristotle, geometric forms structure objects from within, giving the structure of squareness and roundness to the ordinary physical world. Aristotle denies the possibility of abstracting forms in any meaningful sense and locating them outside human experience in some noumenos. Whereas it may be difficult to speak of the instances in Platonism where mathematical knowledge intersects with the world, because of their independence from each other as well as from human apprehension, in Aristotle, numbers exist as simple sums of the objects that one is counting. The number “five” would not have to be a “discrete, idealized from of an object 'five'" (Bostock). Aristotle likewise distinguishes the geometer's activity from Plato's conception. Since the objects of mathematics do not exist in an abstract noumenos apart from the senses, the process of abstracting forms that takes place in mathematics is a process of creation on the part of the mathematician, not of discovery as Plato had taught.

According to Aristotle, furthermore, the geometer does not discover new features of a parallel, idealized realm while going about his work. The necessity of a well-formed formula in Aristotle therefore does not reside in any single, foundational statement about geometry (as it does for Plato). Instead, the necessity is found in "hypothetical statements, statements to the effect that if a certain proposition is true then a certain other proposition is necessarily also true" (Korner 20). Aristotle's discussion of the nature of "if/then" propositions that are used to deduce the properties of mathematical objects (taken up in *Physics II, 9, 200a, 15-19;* and *Metaphysics 1051a, 24-26*) set a powerful precedent in that for centuries, Aristotle's logical method was considered equivalent to logic itself (Veatch 163). As Kant states:

> That logic has already, from the earliest times, proceeded upon this sure path is evidenced by the fact that since Aristotle it has not been required to retrace a single step, unless, indeed, we care to count as improvements the removal of certain needless subtleties or the clearer exposition of its recognized teaching, features which concern the elegance rather than the certainty of the science. It is remarkable also that to the present day this logic has not been able to advance a single step, and is thus to all appearance a closed and completed body of doctrine. (in Veatch 163)

Henry Veatch acknowledges that since the development of non-Euclidean geometries and with them, alternative logical practices, the mathematico-logical structure of Aristotle's method, the syllogism, has come to be seen as "hopelessly outmoded." But he argues that the syllogism still is defensible if it is taken up in the context of Aristotle's philosophy, instead of in the broader context of deduction in general (Veatch 164).

One further contribution that Aristotle makes to a philosophy of geometry is his conception of the paradox of infinity, a paradox that eventually causes the centuries-old epistemological foundations of geometry to splinter in the 1800s. In the *Physics* he distinguishes two ways of describing infinity, as "actual" and as "potential." His own preference was for the latter (Korner 20). The problem of how to define infinity becomes more pressing later when Euclid includes this concept as the fifth postulate in the *Elements*. Aristotle's method for resolving the paradox of a concept that requires definition, though by definition cannot be defined, is to consider the infinite not as a stable, Platonic entity, but as the name for a process. This process for Aristotle involves the "potential" of a step-by-step procedure, where one could always conceivably add another step after the last one is completed. In his model, one could never actually reach "infinity," and thus paradoxically remain within the finite. But one could imagine the process continuing on without an end.

Even in this narrative about the beginnings of a philosophy of geometry, these origins have already become confused, since neither Plato nor Aristotle can be classified exclusively as either analytic or empiricist philosophers. Plato is most often considered an analytic idealist, since his system requires rational thought to apprehend the Forms that exist in a realm apart from human experience. Although Aristotle's philosophy does not have any place for the idealist discoveries of a mind quietly reasoning with itself, his thought could cross into the analyst camp through his assertion of the necessity of clear principles of reason. Philosopher Sir Thomas Heath considers the "logically necessary hypothetical propositions" in

Aristotle as opening the possibility for a (analytical), non-Euclidean geometry that finally emerges as a singularity in the nineteenth century (Heath 11). On the other hand, while Aristotle's empiricist applications are obvious in his insistence on a non-transcendental system of mathematical forms, Plato also can be viewed as an empiricist for his belief that mathematical objects always relate back to the physical world, even in some corrupted form. As Korner states:

> It might be tempting to say that the converse of approximation is idealization; and to regard the statement that some empirical objects and relations approximate to mathematical relations and objects, as being equivalent to the statement that mathematical objects and relations are idealizations of empirical ones. This, however, was not Plato's view. Plato considered mathematics not as an idealization, by the mathematicians, of certain aspects of the empirical world but as the description of a part of reality. (Korner 18)

Chapter One
3.) Standardizing the Rational Tradition

The most comprehensive of Descartes' works, *Principia Philosophiae*, was published in Amsterdam in 1644. In three parts, *The Principles of Human Knowledge, The Principles of Material Things, Or the Visible World and the Earth,* it attempts to put the whole universe on a mathematical foundation reducing the study to one of mechanics. (J. J. O'Connor & E. F. Robertson)

In the two sections that follow, I begin to sketch the rationalist thought of Descartes and Leibniz in order to show the proximity of their work to Euclidean geometry and concepts of efficient technology. Although the strict rationalism of these models differs from the phenomenological approach of posthumanism, I will argue that in fact these two approaches are more closely aligned philosophically than posthumanist Kathryn Hayles will admit. Outlining her rationale for the distance between posthumanism and Cartesian rationalism, she writes:

> [t]o look at thought in this way is to turn Descartes upside down. The central premise is not that the cogitating mind can be certain only of its ability to be present to itself but rather that the body exists in space and time and that, through its interaction with the environment, it defines the parameters within which the cogitating mind can arrive at 'certainties' . . . . What counts as knowledge is also radically revised, for conscious thought becomes an epiphenomenon corresponding to the phenomenal base the body provides. (Hayles 203)

While the distinction between analytical approaches such as Descartes' and Leibniz's and phenomenological approaches such as Hayles must be kept in mind, of much greater significance I contend in Chapters Two and Three is the fact that both of these approaches attempt to apply a mechanistic axiomatic model that assumes the untenable possibility of a machine, either abstract or concrete, operating with complete efficiency.

Descartes' philosophical system was similar to others of the seventeenth century in that it attempted to replace Aristotelian conceptions of the universe that imbued objects with a metaphysical presence that could explain their ontology. As Descartes writes, "But please do not tell people, for that might make it harder for supporters of Aristotle to approve them. I hope that the reader will gradually get used to my principles, and recognize their truth, before they notice that they destroy the principles of Aristotle" (Descartes *DPL* 13). Descartes' attempt to establish a philosophical system that was based on strictly rational principles led him to argue that the universe operated according to mechanical principles, as had Aristotle. As historian David Channell summarizes, "Aristotle argued that the universe was composed of fifty-five concentric crystalline spheres. A number of the spheres added by Aristotle functioned as mechanical linkages and 'idle wheels' so that the motion of the outer sphere of the stars could drive all of the planets" (Channell 13). Despite the similarity of their efficient mechanical models that attempted to explain the phenomena of the natural world, Descartes arrived at his explanation by reasoning that was based on the Euclidean method for establishing a proof: "If extended matter was one pillar of Descartes' world view, the other pillar was motion, which, like matter, was describable in terms of geometry . . . . In place of occult powers and desires, Descartes substituted the mechanical actions of inert matter" (Channell 18).

Part of Descartes' motivation for developing a mechanistic, analytic philosophy was to counter the many non-rational explanations for phenomena in the natural world. Instead of appealing to occult or religious powers for these explanations, Descartes vowed to construct his system on the one faculty that he could trust most completely, that of reason. And for him, no other model of sound reasoning presented itself besides that codified by Euclid in the *Elements*. As Baum states, "[h]e never seriously questioned the validity of the mathematical method (as epitomized by Euclid's Geometry), and he attempted to use this method for constructing a philosophical system which would provide an unshakable foundation for all kinds of knowledge" (Baum 79). Thus, following the Euclidean rational system, Descartes attempts to discover a sound postulate about himself, on which he could construct the rest of his philosophy.

Descartes' approach, then, can be characterized by its fundamental principle of doubt. He does not believe that pre-conceived notions such as "theology, the philosophical tradition, the common sense of everyday life . . . mysticisms of all sorts . . . and superstitions such as those which asserted an identity between madness and witchcraft" (Boyne 36) should influence the mind attempting to discover the foundations of knowledge. Instead, according to Descartes, that mind should remain detached from all the ideas swirling around it, and, based on its own independent method, discover the epistemological bedrock on which he could construct his philosophy:

> Since Descartes hoped to replace faith with experiences that were more certain, he begins by placing everything in doubt that would normally be trusted. The way to ascertain which of these doubted conceptions could be revived and built upon is through the exercise of his rational faculties. (Boyne 36)

Once he has discovered a fundamental truth about himself, he believes that the law of cause and effect, a mechanical principle, will enable him to extrapolate the functioning of the entire universe. In light of Descartes' belief that the axiomatic method as composed by Euclid could explain all the phenomena of the universe, Bostock states: "All science, for Descartes, therefore, consists of applying the principles of *a priori* reasoning. This is perhaps the boldest view that there has ever been of the scope and power of pure mathematics" (Bostock). However bold his view of pure mathematics, the *a priori* method that he derived from it caused him to make mistaken assertions about the functioning of the universe. For example, his mechanical system did not accept the influence of an invisible force such as gravity, as Newton proposed, but instead required a series of vortices that would cause action in proximity. The rigor of Descartes' systematic method influenced its adoption as the model for scientific work in the years that followed. His assumption that the universe was essentially mechanical in operation, and could be explained as a series of causes and effects, and his skeptical method of doubt, of systematically submitting each proposition (or, in the language of Euclid, each postulate and theorem) to the light of reason, "was an important point of view," according to O'Connor and Robertson, "and was to point the way forward" (O'Connor and Robertson).

Although he begins by focusing his reasoning mind on himself, Descartes nonetheless accepts that it could be possible for him to doubt the existence of his own body. His rationale for this doubt is that some madmen's "brains are so damaged by the persistent vapours of melancholia that they firmly maintain . . . that their heads are made of earthenware . . . or made of glass" (Descartes *Discourse*). He feels that from his position of contemplation, it would be impossible for him to determine whether he is in fact dreaming or awake, since he could be dreaming up the certainty that he has about his body and his surroundings.

Descartes' doubt about the ability of his senses to convey reliable information to him about the world is expressed in his well-known reasoning about the piece of wax that "has been taken quite freshly from the hive" (Descartes *Meditation II*). His doubt about the empiricist method derives in part from the mutability of the physical world around him. When the wax is placed on a fire, he states,

> What remained of the taste is exhaled, the smell evaporates, the colour alters, the figure is destroyed, the size increases, it becomes liquid, it heats, scarcely can one handle it, and when one strikes it, no sound is emitted. Does the same wax remain after this change? We must confess that it remains; none would judge otherwise. What then did I know so distinctly in this piece of wax? (Descartes *Meditations II*)

After some speculation about the nature of the physical world and human knowledge, he concludes along similar lines:

> We must then grant that I could not even understand through the imagination what this piece of wax is, and that it is my mind alone which perceives it . . . . But what is this piece of wax which cannot be understood excepting by the understanding or mind? . . . . What must particularly be observed is that its perception is neither an act of vision, nor of touch, nor of imagination, and has never been such

> although it may have appeared formerly to be so . . . (Descartes *Meditations II*)

What Descartes finds trustworthy about the piece of wax are only those qualities that he can apprehend through his geometric method. As philosopher Margaret Osler writes, "the wax for Descartes consists primarily of its geometric properties, properties of extension, that could be apprehended apart from having to use one's senses. The nature of matter, or of body, considered universally, does not consist in the fact that it is hard, heavy, coloured, or any other mode affecting the sense; but only in that it is a thing extended in length, breadth, and depth" (Osler 216). Finally, since Descartes does not feel that any knowledge he receives about the outside world is reliable because it comes to him through his senses, the one foundational principle at which Descartes arrives, after doubting the veracity of everything else, is his own existence. This realization leads him to his well-known dictum "*cogito ergo sum.*"

Descartes concludes that he has discovered something foundational about the world, since through the geometric axiomatic method he has carefully eliminated any knowledge that he may have gained that might somehow be faulty. The knowledge of his own existence does not pass through his senses before being understood through the cognitive powers of his mind. Therefore he believes that he has discovered not only the one principle on which to construct the rest of his *a priori* philosophy, but also the method for doing so. Boyne's discussion points out the assumption that Descartes makes regarding the possibility of contradictory statements both paradoxically remaining valid, which I discuss in greater detail at the end of this chapter:

> He knows -- implicitly, for he neither discusses nor admits this, and so it would perhaps be better to say believes rather than knows -- that at least one law of logic is absolutely valid: the law of non-contradiction, that a thing cannot be both p and not p at the same time, that he cannot be both existing because thinking and not existing because deceived at the same time. (Boyne 39)

That a principle of contradiction could indeed operate, with two oppositional statements both remaining true, is discovered in the geometric models that are developed in the nineteenth and early twentieth-centuries. But Descartes himself does not doubt the law of non-contradiction since, as he asserts, his *cogito* can be seen as 'true' by the 'natural light' of the mind. The fact that his mind can perceive ideas that are clear and distinct, apart from needing to depend on God for their existence, demonstrates to Descartes the validity of his conclusions.

From here, furthermore, Descartes believes that the mechanical principle exemplified in his analytic, geometric method can be extended outward to explain other phenomena of the natural world. Although many of his conclusions are incorrect, according to Bostock,

> Descartes is the first to extend the relevance of mathematics to include time, motion and space. Then he assumes that that the basic principles of geometry, which are known a priori, will explain the laws of motion . . . . He establishes the solar system as a collection of vortices. He also thinks this system can explain the rest of the universe, from the behaviour of light to the pumping action of the heart. All science, for Descartes, therefore, consists of applying the principles of a priori reasoning. (Bostock)

By contrast, Isaac Newton objects both to Descartes' *a priori* method and to his conclusions. Newton's laws of motion and of gravity allow for "action at a distance," a principle that called Descartes' mechanical system into question. Furthermore, Newton uses the empirical "scientific method" of observation and experimentation to support the consistency of his "laws." But even after Newton demonstrated that his theory indeed reflected the actual motion of objects in relation to gravitational fields, Descartes' vision remained popular. This vision described the universe in mechanical terms that could be understood through the principles of induction that were established in Euclid's *Elements*. Although Descartes thought that deploying a mechanical model would place his philosophy on more stable ground because of its appeal to reason instead of intuition, this same model raises many further questions about the status of life, especially when applied to current issues involving technology and intelligence. As philosopher Stephen Asma states in his essay "Descartes meets Blade Runner," "Descartes argued that non-human animals were brutes incapable of thought and therefore incapable of having basic rights and respect. Kick a dog all you want, [but] don't worry, it's just a machine" (Asma). Despite the apparent denigration of animal-machines in relation to humans because they could not solve intellectual problems, Descartes nonetheless writes that humans can achieve what he thought was the mechanical perfection of animals through the faculty of reason. As theorist Bruce Mazlish states in his history of machinic thought, *The Fourth Discontinuity: The Co-Evolution of Animals and Machines*, "Having earlier told us that Man differs from the animal-machine because he can err, Descartes now proposes that Man transcend his own nature. By reason -- and in accordance with Descartes' famous method of reasoning -- Man 'acquires the habit of not erring . . .

since this comprises the greatest and principal perfection of Man'" (Mazlish 21). Mazlish continues, explaining why he includes Descartes in a genealogy of cyborgs: "Intrigued with the mathematical-mechanical possibilities, Descartes very early on imagined a Man-machine to be activated by magnets and is reported to have planned machines to simulate a flying pigeon and a pheasant hunted by a spaniel" (Mazlish 22).

Although Foucault's reading of Descartes does not directly address the underpinnings of Euclidean geometry that hold Cartesian rationalism in place, Foucault critiques Descartes' logic in the historical context of Renaissance constructions of madness. The prevalence of fabulation ("forms of unreason, of magic, madness, revelation, faith healing, miracles" [Boyne 44]) energizes Descartes' attempt to construct a rational human subjectivity. To place his rationalist project in perspective, Foucault contrasts his work with that of Descartes' contemporary, Montaigne. A typical sample of Montaigne's non-rational work from his letters would be the following:

> Although there is nothing strange in seeing horns grow in the night on foreheads that had none at bedtime, there is something memorable about the case of Cippus, King of Italy. During the day he had been a passionate spectator at the bullfight, and all night long he had worn horns in his dreams. His forehead actually sprouted them by the power of the imagination. (Montaigne 37-8)

Montaigne describes subjects with occult powers who practise magic and offers no rational explanation for this practice, thereby representing a view of the human subject that precedes the seventeenth century. Boyne's view is similar to Foucault's on the importance of this historical shift:

> We have here a fundamental distinction between, on the one hand, the kind of thinking that will acknowledge the limits of both its actual and potential knowledge, and therefore is not prepared to dismiss unreason, and, on the other hand, the autonomy, sovereignty and sobriety of the rational subject presented by Descartes. (Boyne 45)

More than simply showing that Descartes considers himself to be a sane thinker who carefully makes his way forward using the tools of logic, Foucault posits that Descartes' method shows a new way of conceptualizing subjectivity. Instead of allowing for the presence of non-mechanical or non-contingent powers, even through a concept of God (in whom Descartes still believed), his human subject was shaped into a completely rational being. In describing subjectivity primarily in terms of intellection and Euclidean logic, Descartes constructs a subject who aspires to sovereignty over the world instead of integration within it. Furthermore, Descartes' subject believes in his own power to achieve this sovereignty through the rational powers of his own being, instead of through any external or occult source.

According to Foucault, something historically shifts between Montaigne, who can accept the presence of fabulation as a natural occurrence in the world, and Descartes, who cannot. As Foucault writes,

> between Montaigne and Descartes, something has happened; something which concerns the advent of a logic. But it is far from the case that a history of a logic like that of the western world is fully explained by the progress of a rationalism; it derives in large part from that secret movement in which unreason is plunged deep

> under the ground, there no doubt to disappear, but there also to take root. (Foucault *HM* 58)

Since Descartes uses reason to demonstrate the trustworthiness of reason, he needs to exclude madness (a figure for the non-rational world of dreams, intuitions, sensations) from his system. Boyne notes the significance of Descartes' exclusive reliance on a geometric rational model:

> This exclusion is momentous. It affirms the sovereignty of the sane, rational subject with free will over an extended world of things, a world without essential quality whose exploitable plasticity can be controlled by a mind which has a natural understanding of mathematical logic and causality. The consequences of this dualistic ontology have been horrific; for example, the science of nuclear weapons and germ warfare, and the decisionism of the Holocaust. (Boyne 48)

Boyne continues his discussion of the relation between Foucault and Cartesian rationalism by drawing attention to Descartes' "refusal to question reason itself" (Boyne 48). In this reliance on reason, Boyne asserts, Foucault is a "contemporary Descartes" (Boyne 50). What his comment fails to address is the distinction between their two approaches, Descartes constructing an independent rational figure who became the centre of liberal humanist approaches, Foucault asserting the death of this same figure through the determinist influence of historic epochs.

Furthermore, Boyne's comments fail to address the complex benefits that Cartesian rationalism also introduced into scientific practice. As Margaret Osler states:

> He thought . . . that his mechanical explanation of qualities gave a better account of the phenomena of nature. The existence of real qualities had provided the Aristotelians with a warrant for claiming the reliability of sensory experience. If a body perceived to be hot really contains the quality of hotness, then it is possible to know something about its inner nature empirically. While Descartes did not reject Aristotle's essentialism, he did reject Aristotle's opinion that essences can be known empirically, claiming instead that they can be known only by a priori methods. (Osler 216)

While Descartes' *a priori* method led him to erroneous conclusions, this same method freed him from assuming that geometric objects had any specific properties of their own. This approach revolutionized earlier approaches to geometry, because it brought the functions of algebraic thinking to the logic of the geometric proof. Thus, according to historian Peter Schoules,

> For the ancients, perceptual objects, whether given through the corporeal imagination, were taken to be individuated; they were distinguished from other entities through their own physical properties. As abstract concepts, the objects of Descartes' analytic geometry, having no necessary relation to physical existence, have their nature determined not through properties taken to be exclusively their own but through the conceptual relations of the intellectual context in which they function. (Schoules 119)

Descartes' analytical method, which therefore does not need the actual computability of space for its process, influences not only Kant's conception of the *a priori* forms of the mind that organize perception, but also the early twentieth-century analytic mathematics of Alfred North Whitehead and Bertrand Russell. As Schoules states:

> Whitehead echoes these statements of Descartes: 'For the sake of convenience, we shall employ the letters a, b, c, etc. to express magnitudes . . . . With this device we shall not just be economizing with words, but, and this is the important point, we shall also be displaying the terms of the problem in such a pure and naked light that, while nothing useful will be omitted, nothing superfluous will be included ó nothing, that is, which might needlessly occupy our mental powers when our mind is having to take in many things at once'. (Schoules 167)

The nineteenth and twentieth-century logicism of Gottlob Frege, Bertrand Russell and Whitehead owes much to the analytic method first formalized by Descartes. However, as I argue below, the logicist attempts at sealing Euclid's system are undermined by Gödel's Theorems, demonstrating the inefficiency of self-validating systems.

Chapter One

4.) Epistemology as Pure Reason

I present the following expository sketch of Leibniz's rationalist philosophy in order to demonstrate its contribution to rationalist epistemology, especially in the nineteenth-century work of Russell and Whitehead that I discuss in greater detail below. This study also demonstrates the ironic role Leibniz's rationalism plays in the development of non-Euclidean geometry since it is the first to systematize a formal language of mathematical characters and signs so that they are "related to each other as are the corresponding thoughts" (Korner 25). This practice takes many forms for Leibniz, and one of them anticipates Kurt Gödel's practice of arithmetizing logic, which leads in turn to his theorems of Undecidability which challenge the complete efficiency of rationalist models such as Leibniz's.

According to Baum, "Leibniz considered his philosophy to be a refinement and extension of Descartes' philosophy" (Baum 150). Like Descartes, Leibniz attempts to construct his epistemology on rational, *a priori* principles. As he writes:

> We may say that knowledge is received from without through the medium of the senses because certain exterior things contain or express more particularly the causes which determine us to certain thoughts . . . When, however, we are dealing with the exactness of metaphysical truths, it is important to recognize the powers and independence of the soul which extend infinitely further than is commonly supposed. (Leibniz *D* 27)

These metaphysical truths were figured in his conception of monads, which were for Leibniz the most fundamental entities in the universe. He felt that these entities surpassed Descartes' *cogito*, and the distinction upon which the *cogito* was based, between the mental and physical world. Leibniz does, however, borrow from Descartes' epistemology, and like him becomes caught in the circular reasoning that assumes the validity and clarity of his thought simply because he thinks it.

Like others before him, Leibniz grounds at least part of his analytical philosophy in what he believes to be the *a priori* truth of Euclidean geometry. He makes this connection through his understanding of epistemology, where he distinguishes between two kinds of knowledge:

> There are . . . two kinds of truths, those of reasoning and those of fact. Truths of reasoning are necessary and their opposite is impossible, and those of fact are contingent and their opposite is possible. When a truth is necessary its reason can be found by analysis, resolving it into more simple ideas and truths until we reach those which are primitive. It is thus that mathematicians by analysis reduce speculative theorems and practical canons to definitions, axioms and postulates. (Leibniz *M* 135)

Although Leibniz's reliance on "analysis" to determine whether truths are those of reason or of fact makes his work essentially Platonist, he also borrows from Aristotle's logic when he assumes that "every proposition is in the last analysis of the subject-predicate form" (Korner 22). According to Korner, Leibniz's meaning at this point becomes unclear, since he (Leibniz) asserts further, that "the subject 'contains' the predicate" (Korner 22). And in order to defend this assertion, Leibniz is obliged to turn to broader metaphysical ideas, those of God and of infinity.

Leibniz's construction of a philosophy of mathematics with which to structure his *a priori* epistemology draws on the apparent foundational status of Euclidean geometry, as had Descartes before and Immanuel Kant, who follows him. As Korner states:

> Mathematical propositions to him are like logical propositions in that they are not true of particular eternal objects or of idealized objects resulting from abstraction or indeed of any other kind of object. They are true because their denial would be logically impossible. (Korner 23).

Like Descartes, then, Leibniz is credited with forging stronger links between the practice of logical induction and the discipline of mathematics. As Leibniz himself asserts, in a later text:

> It is by this natural light that the axioms of mathematics are recognized; for example, that if from two equal things the same quantity be taken away the things which remain are equal; likewise that if in a balance everything is equal on the one side and on the other, neither will incline, a thing which we foresee without ever having experienced it. It is upon such foundations that we construct arithmetic, geometry, mechanics and the other demonstrative sciences . . . . (in Baum 124)

The analytical foundations upon which arithmetic, geometry and mechanics are constructed are so solid for Leibniz that he develops a method of calculation which he brings to bear not only on the process of reasoning that is necessary for establishing mathematical proofs, but on reasoning processes that take place anywhere.

However, when Korner states that Leibniz "introduces the methodological idea of using mechanical calculation in aid of deductive reasoning" (Korner 22), the term "mechanical" does not refer only to some cold, machine-like system of inter-locking causal relations. In fact, the complexity of the calculus that Leibniz develops reflects a complexity that manifests itself in the fluid interactions of a world teeming with life. For this reason Deleuze states that "The definition of Baroque mathematics is born with Leibniz"(Deleuze *L* 17). Building on his idea of the fundamental entities of the universe as monads that can be apprehended using the rational principles modeled in geometry, Leibniz understands the universe as essentially curved in shape. This curvature, according to Deleuze, is maintained by three other "fundamental notions: the fluidity of matter, the elasticity of bodies, and the motivating spirit as a mechanism" (Deleuze *L* 4). Instead of constructing a model for the universe that is atomistic, as is often assumed, Leibniz's ideas about the universe as fluid counter Descartes' belief that this fluidity would cause all entities to finally lose their texture. Drawing on architect Bernard Cache's description of the point of inflection, Deleuze argues that the originality of Leibniz's thought stems from his attempt to bring together both an atomistic and fluid hypothesis to explain movement in the world.

> That is what Leibniz explains in an extraordinary piece of writing: a flexible or an elastic body still has cohering parts that form a fold, such that they are not separated into parts of parts but are rather divided to infinity in smaller and smaller folds that always retain a certain cohesion. Thus a continuous labyrinth is not a line dissolving

> into independent points, as flowing sand might dissolve into grains, but resembles a sheet of paper divided into infinite folds or separated into bending movements, each one determined by the consistent surroundings. (Deleuze *L* 6)

As with Descartes' use of the axiomatic method, Leibniz uses this same method when he constructs his (Baroque) philosophy of inflection, curves, dynamic forces out of his initial postulates. These postulates make assertions regarding the nature of the monads, and the necessity of calculation as a first step in the process of understanding them. As the translator of Deleuze's text notes, "Leibniz's mathematics of continuity and modulation change . . . our ideas about the object and event" (Deleuze *L* xix). Leibniz's rationalist model of the universe, which combined the fluid and the mechanical into a series of infinitely divisible folds, anticipates current issues involving the possibility of machinic intelligence. For example, philosopher Paul Raymont sees in Leibniz's system the grounds for rejecting the possibility of an intelligent machine that could rival the complexity of the "natural machine," the human being. His assertions further my claim that the rigour of Leibniz's methodology leads ironically to models that inscribe inefficiency into their operations:

> Leibniz's remark that artificial machines (made by humans) are not machines in all their parts is profound: it anticipates the Church-Turing thesis. God's art may well be superior to ours, but it is also incomprehensible. The life grid in each of our model monads [for technology] is only finitely complex, because it is only finitely divided. (Raymont)

Raymont's assertion regarding the limited possibility of a complete machine/ human integration in Leibniz is grounded in the Church-Turing thesis of the early twentieth-century, which argues that all mechanical structures will halt and loop at some point in their computational cycle. I address this thesis in greater detail in Chapter Three when the discussion focuses more specifically against the technological optimism of Kathryn Hayles's posthumanist model.

In contrast to Raymont, philosopher George Macdonald Ross considers Leibniz's rationalist philosophy to offer an early example of a high level cyborg. Quoting Leibniz's *Monadology* ("when controversies arise, there will be no more need for a disputation between two philosophers than there would be between two accountants. It would be enough for them to pick up their pens and sit at their abacuses, and say to each other . . . 'Let us compute'"), he continues:

> Although he refers to 'abacuses', he must have had in mind an extension of this own calculating machine, in other words, something like the modern computer. Indeed, his position is as radical as that of the most hard-line modern proponents of artificial intelligence, in that he places computability above human judgment. (G. M. Ross)

Indeed, from this perspective, the philosophies of both Descartes and Leibniz, linking together geometric, rationalistic and mechanical concepts, anticipate the aims of the posthumanist philosophy in the late twentieth century in the shared goal of positing a complete fusion between the technological and biological realms. As cybernetic pioneer Norbert Wiener argues in *Cybernetics or control and Communication in the Animal and the Machine*,

> At this point there enters an element which occurs repeatedly in the history of cybernetics -- the influence of mathematical logic. If I were to choose a patron saint for cybernetics out of the history of science, I should have to choose Leibniz. The philosophy of Leibniz centers about two closely related concepts -- that of a universal symbolism and that of a calculus of reasoning . . . . Now, just as the calculus of arithmetic lends itself to a mechanization progressing through the abacus and the desk computing machine to the ultra-rapid computing machines of the present day, so the calculus rationcinato, of Leibniz contains the germs of the machina rationcinatrix, the reasoning machine. (Wiener 12)

Leibniz's applying *a priori* reasoning to philosophy, applying logical principles of the mathematical calculus, "anticipated modern movements, in particular the modern logicism," of Gottlob Frege and Bertrand Russell, much as Descartes' analytical philosophy influenced the work of A. N. Whitehead and Bertrand Russell as well (Korner 22).

Chapter One
5.) Tracing Geometry's Roots (I)

The Greek geometer Thales is credited with originating the premises of Descartes' and Leibniz's analytical philosophy, of turning to Euclidean geometry for foundational support for epistemological theories. He begins by extrapolating abstractions on the basis of principles that determined whether the measurements of geometry were indeed accurate, "geometry" taking its name from the practice of measuring plots of land (Trudeau 2). Thales' technique of drawing abstractions from geometry initiated the movement away from knowledge that was based on mythical stories and magical powers toward knowledge that could be represented through formal demonstrations and proof: "Thus Thales makes the suggestion that the practice of geometry should become an abstract, mental activity, instead of a concrete one for measuring plots of land, architectural structures and distances between landmarks and towns" (Trudeau 3). Thales' early work furthermore lays the groundwork for considering 'mechanism' in abstract terms, linking this metaphor with the logical processes of the mind.

For the Pythagoreans, the mystical community that follows him, however, Thales' abstract geometry helps explain the metaphysical foundations of the universe. They advance Thales' work by developing a more formal system for establishing geometric proofs than he had. Although Thales had used a combination of intuition and logic, the Pythagoreans attempted to make the whole process entirely logical, believing that this rationalism would ground their results more firmly. However, by following the steps of their logic all the way through to the end, the Pythagoreans discovered a conflict in mathematical reasoning between their use of logic and of intuition in the attempt to confirm the validity of their results. Trudeau outlines the logical steps they took on their way to discover the class of numbers they called “irrational.”[4] But the fact that they priorized logic over intuition applies not only to their discovery of irrational numbers, but to the practice of establishing geometric proofs on the whole. Thus, according to Trudeau,

> the Pythagorean heritage is what modern mathematicians call ‘rigor’, a habit of mind characteristic of mathematics. Every effort is made to insulate the subject from its down-to-earth origins. Terms are defined and principles formulated with constant vigilance against unstated assumptions. Theorems are derived by logic alone. (Trudeau 5)

While this model might seem self-evident today, as I discuss later in this chapter, mathematicians such as L. E. J. Brouwer in the twentieth-century have attempted to make geometric practice more rigorous by reintroducing intuition into its steps of induction.

For the analytic philosophers who followed Thales and then the Pythagoreans, the tendency to separate the empirical world from the rationalist principles of geometry increased. Plato systematizes this tendency of separating the two within the framework of a broader philosophical system. Following Plato, however, Euclid’s summary of geometric knowledge in the *Elements* formalized this process still further, by using Aristotle’s axiomatic method to develop geometric proofs. As philosopher of mathematics Carl J. Posy states:

> Euclid’s dependence on visual intuition (whose consequent deductive gaps were already noted by Archimedes), together with the challenge of Euclid’s infamous fifth postulate (about parallel lines) established an agenda for generations of mathematicians. (Posy 594)

The impossibility of meeting the challenge presented by features of Euclidean geometry such as the ‘infamous fifth postulate’ contributes to the development of non-Euclidean geometries in the nineteenth and twentieth-centuries that include the inefficiency of their patterns of logic in the models themselves.

Chapter One
6.) Tracing Geometry's Roots (II)

Around the fifth-century B.C. geometers were following the precedent set by Thales, linking chains of theorems in which each was deduced based on the one that had preceded it, much like they would build a simple machine. Each of these deductive chains began with a generalization from experience that was true for the geometer, but needed to be accepted as such, without formal proof. As more of these networks of theorems were formed, many geometers began attempting to link them all together into a single system, basing all of them on just a few principles that could include the whole. The first attempt at this systematization was performed by the mathematician Hippokrates of Chios in a text called *Elements*. Over the next several hundred years, more geometers focused their attention on making the practice of geometry rigorous, writing more books that all took the same name as the initial one by Hippokrates. Around 300 B.C. Euclid's *Elements*[5] ended this practice, since it surpassed those *Elements* that had come before in both its breadth and thoroughness. Euclid's *Elements* became well-known, not for the new geometric principles that it introduced, but for its comprehensive summary of geometric thought at the time. His text comprised a network of 465 theorems, including not only geometric theorems, but also studies of algebra and number theory. As Trudeau summarizes, "its organization and level of logical rigor were such that it soon became geometry's standard text. In fact it so completely superseded previous efforts that they all disappeared" (Trudeau 5).

Euclidean geometry provided the epistemological model for much of Western philosophy, representing the oldest example of a logical method known as a "material axiomatic system." According to Trudeau, a material axiomatic system consists of four classifications of terms. In the first, the geometer introduces fundamental terms that are called "primitive terms." The geometer offers a general explanation about these primitive terms before proceeding with his proof to the next level. The second level consists of a list of primary statements. These primary statements are putatively about the primitive terms, but in order for them to contain meaning for a reader, they need to be acceptable based on this connection with the primitive terms. They only have relevance based on this relation with the first level of terms. This second level of primary terms is called "axioms." The third level contains technical terms that take their definitions from terms that were introduced earlier and are accordingly known as "defined terms." Finally, the fourth level only accepts statements that can be logically deduced from the terms or statements that have been accepted in the first three levels beneath it. The geometer calls these deductions "theorems."

This system might seem to be logically stable at each stage, leading from the primitive statements at the foundation to the theorems at apex. But since even dictionaries are circular, or tautological, certain terms and statements need to be accepted on the basis of their usage in society in order for the proof to proceed. For example, although the technical terms of the third level are carefully defined in relation to the primitive terms of the first, these primitive terms themselves need to be accepted by the geometer "without the benefit of precise definition" (Trudeau 6). Likewise, the statements that make up the "theorems" of level four are structured out of the primary statements in the second level. However, this second level category also needs to be accepted by the geometer before the proof can proceed. The deductive proof can only recede so far back in relation to the terms that it itself deploys to establish a logical axiomatic proof, based on Aristotle's axiomatic: the "if/then" system of logic.

Despite the high regard given to Euclid's *Elements* because of its strict logical method, many logicians have also noted the inconsistency in Euclidean logic, since its conclusions derive from appeals to intuition that are also combined with appeals to logic. Mathematician I. Grattan-Guinness underscores the significance that was accorded to Euclid's method:

> From the point of logic and rigor, Euclid was thought to be an apotheosis of certainty in human knowledge; indeed, 'Euclidean' was also used to suggest certainty, without any particular concern with geometry. Ironically, investigations undertaken in the late nineteenth century showed that, quite apart from the question of the parallel axiom, Euclid's system actually depended on more axioms than he had realized, and that filling all the gaps would be a formidable task. Pioneering work done especially by M. Pasch and G. Peano was brought to a climax in 1899 by D. Hilbert (as I discuss below), who produced what was hoped to be a complete axiom system. (Grattan-Guiness 250)

One could argue that the presence of intuition is inevitable, since the proof needs to begin somewhere instead of receding to increasingly fundamental terms. Because of this difficulty with Euclid's logical method, the mathematical logician J. B. Rosser proposes to counter the methodology of the Pythagoreans and those that followed, giving intuition priority over logic:

> The mathematician should not forget that his intuition is the final authority, so that, in case of irreconcilable conflict between his intuition and some system of logic, he should abandon the logic. He can try other systems of logic, and perhaps find one more to his liking, but it would be difficult to change his intuition. (Rosser 11)

Trudeau continues along the same vein, arguing that "[m]uch as the mathematician would like to seal his system off from intuition, which he considers unreliable, core intuitions penetrate every barrier. Logic itself rests on intuition, and may be contaminated with intuition's unreliability" (Trudeau 10). Formal acknowledgement that a purely rational method is untenable does not emerge until Gödel's Undecidability Theorems of 1931, the increasing realization that intuition plays a (suppressed) role in the 'rational' process of establishing a proof, I argue, indicates that fissures are beginning to form on the edifice of analytical Euclidean epistemological models.

According to the philosopher of science Michel Serres, traces of intuitive influences are present even in the first geometric work of Thales. One of Thales's first geometric projects involves determining the volume of a pyramid based on the volume of the shadow thrown onto the sand from the glaring desert sun. From this empirical practice, physical objects become transparent, allowing the sun to shine through them, leaving only their forms as husks accessible to the geometers. Since these geometric theorems are established based on the residue of intuitions that have developed through empirical experiences of space, they are never able to purge themselves of the contamination of intuition in order to free up the practice of a pure, logical geometry. Serres asserts that geometers such as René Descartes (1596-1650), Gerard Desargues (1591-1661), Gaspar Monge (1746-1818), Joseph Gergonne (1771-1859) and the twentieth century's Edmund Husserl re-tell the story of origins in their theorems. For Serres, this re-telling always recedes because the blend of residual empiricism and intuition reduces their potentially logical system into a language of representation. "Mathematical realism is weighed down and takes on the old density that Plato's [analytical] sun had dissolved. Pure and abstract idealities create shaded areas; they are full of shadows; they become again as black as the pyramid" (Serres 96).

Although Serres critiques geometric systems that function as a representational language, he does not pursue the complexities produced by non-empirical, analytical systems whose language attempts to maintain "purity and simplicity" (Serres 96). For him the "pure geometry, inherited from Plato," (and by inference, from Euclid, whose geometry was also Platonist [O'Connor]) dies at the same moment that intuitionism dies in mathematics. But this death precipitates the birth of a new, chaotic geometric practice, which "develops in a lexicon that derives in part from technology" (Serres 96). However, Serres' focus on the representational systems of geometries that rely on an unacknowledged intuitionism and empiricism opens him to Plotnitsky's criticism. Plotnitsky directs his critique at Serres in the context of a discussion about the distinction between productive and non-productive theoretical economies. He asserts that "Michel Serres' economies" exemplify work based on classical models, models that are ultimately "*epistemologies* rather than *anti*-epistemologies" (Plotnitsky *C* 18). Plotnitsky's comments are warranted, for Serres shows the impossibility of recovering origins in the representational structure of empirical geometry by aligning himself with the "pure" analytical geometry of Plato and Euclid.

An anti-metaphysical orientation similar to Serres' is also practiced by Deleuze in speaking of Husserl's proto-geometry and by Derrida in writing of Husserl's geometric "origins" in Thales. However, unlike Deleuze's approach, Serres' own reading is limited by the unacknowledged presence of paradoxes at the heart of the non-representational logicist geometry initiated by Plato and Euclid. Serres fails to account for the operation of intuition at the very heart of the analytical enterprise. By contrast, Trudeau discusses the role intuition plays in logical systems like the *Elements*:

> In 1800 most mathematicians revered the *Elements*, which they regarded as the supreme example of airtight deductive presentation. By 1900, due to crises in the foundations of several branches of mathematics, in particular to the crisis in geometry precipitated by the invention of non-Euclidean geometry, most mathematicians

> were contemptuous of the old masterpiece and regarded it as a logical sieve. It had been examined more ruthlessly than ever before and found to be shot through with intuitive notions the Greeks and their successors had overlooked. (Trudeau 37)

Yet, as late as 1870, with proposals for a non-Euclidean geometry undermining Euclid's edifice of scientific rigor, the physiologist, physicist, and philosopher Hermann von Helmholtz (1821-1894) still speaks of the logical certainty that he thought Euclid's *Elements* described:

> The fact that a science can exist and can be developed as has been the case with Euclidean geometry, has always attracted the closest attention among those who are interested in questions relating to the bases of the theory of cognition . . . . It escapes the tedious and troublesome task of collecting experimental facts, which is the province of the natural sciences in the strict sense of the word; the sole form of its scientific method is deduction. Conclusion is deduced from conclusion, and yet no one of common sense doubts but that these geometrical principles must find their practical application in the real world about us. Land surveying, as well as architecture, the construction of machinery no less than mathematical physics, are continually calculating relations of space of the most varied kind by geometrical principles . . . . (in Trudeau 106)

Although, on some foundational level, the epistemology represented in the logical structure seems to be compromised by the necessary presence of intuition, the fact that Euclid's geometry can actually be practised in the physical world by architects and engineers has tended to lend it credence despite misgivings by philosophers of mathematics.

Euclid divided his *Elements* into 13 books. Books 1-6 address plane geometry; books 7-9 number theory; book 10 irrational numbers; and books 11-13, three-dimensional geometry. Euclid opens the *Elements* with definitions, and a list of five postulates. The first of these, as do the two that follow, describes the construction of geometric objects: "it is possible to draw a straight line between any two points" (in O'Connor). Euclid begins with the assumption that the objects of geometry actually exist, "implicitly assuming the existence of points, lines and circles and then the existence of other geometric objects [which are] deduced from the fact that these exist" (O'Connor). As the logicist philosopher Irving M. Copi contends: "Every deductive system, on pain of falling into circularity or a vicious regression, must contain some axioms (or postulates) which are assumed but not proved within the system" (Copi 155). The second and third postulates are based on similar assumptions, beginning with the accepted notion that straight lines and circles are unique geometric objects and are possible to construct.

The fourth and fifth postulates differ from Euclid's first three constructive postulates, ultimately opening the way for non-Euclidean geometries some two millennia later. The fourth postulate, that all right angles are equal, might appear to meet Euclid's criteria of being self-evident. However, as Trudeau asserts, "the truth of Postulate 4 is not obvious" (Trudeau 41). As he explains:

> While [Euclid's Tenth Definition of his primitive terms] does say right angles come in equal pairs, it does not compel us to believe two right angles in one part of the plane are equal to two others somewhere else. Suppose the two [pairs of right angles] are billions of miles apart. If <1 = <2 and <3 = <4, then by Definition 10 each of angles 1, 2, 3, and 4 is properly called a "right" angle. But is <1 = <3? It's true that calling both <1 and <3 "right" angles *suggests* they are

> equal; but on that ground the angles we call "acute" should all be equal. Couldn't it be that the plane's character evolves over the vast distance between <1 and <3? In fact wouldn't it be remarkable if the plane were uniform over its entire unlimited extend? But that is just what we imply when we say that, necessarily, <1 = <3 . . . . [Postulate 4] tells us. . .that the plane *is* uniform, at least to the extent that right angles are the same no matter where they are. (Trudeau 41)

Euclid assumes that space will be uniform across vast distances, and he also assumes that the geometric object will remain unchanged by its location in this space as well (O'Connor). Euclid similarly assumes the uniformity of space in his fifth postulate, where he states that only one line can pass through a point that is parallel to another line. The weakness that undermined this fifth postulate for classical geometers was not that the Postulate of parallel lines could not in fact be true, but that one could not use common sense to determine that it was true. According to Copi, "The older conception of Euclidean geometry held not only that all of its theorems followed logically from its axioms, and were therefore just as *true* as the axioms, but also that the axioms were *self-evident*" (Copi 155). The fact that the lines were assumed to continue indefinitely into space while maintaining the same parallel character was problematic for geometers who wished to assert the foundational status of Euclid's *Elements*. Already in the fifth century, a writer by the name of Proclus identifies this problem in the fifth postulate: "This ought even to be struck out of the Postulates altogether; for it is a theorem involving many difficulties" (in Copi 156). Indeed it seems, as Trudeau notes, that Euclid "put off using Postulate 5 as long as he could" (Trudeau 44). The fact that the first 28 of 48 theorems in Book One are established without using this Postulate at all, therefore, is central to my argument here, since even at its inception Euclid's epistemological model is not able to fully address the challenge presented by non-logical aspects of attempting epistemological certainty. The difficulty represented by the fifth postulate leaves the door open for the development of other non-Euclidean epistemological models, including Gödel's Theorems, as I discuss in detail below.

Despite the difficulties that were caused by Euclid's fifth postulate, much energy was devoted to demonstrating its validity because of the eminence granted to his deductive method on the whole. For example, Thomas L. Heath, the translator of the *Elements* from the Greek in 1908, effusively states:

> This wonderful book . . . is and will doubtless remain the greatest mathematical textbook of all time . . . . Even in Greek times the most accomplished mathematicians occupied themselves with it: Heron, Pappus, Prophyry, Proclus and Simplicius wrote commentaries; Theon of Alexandria re-edited it, altering the language here and there, mostly with a view to greater clearness and consistency. (in O'Connor)

Throughout the history of mathematics, many geometers attempted to resolve the problem posed by Euclid's fifth postulate. Since one of the operating principles for mathematicians is that it is "inelegant" to assume more than is necessary to establish a proof, mathematicians felt obligated to place this postulate on firmer ground. Furthermore, since many felt that Euclid had intended all of his postulates to be self-evidently true, the fact that this fifth postulate did not seem to meet this standard gave further impetus to defending it. Thus, "its status as an axiom was more than mathematically inelegant – it was philosophically objectionable" (Trudeau 118).

The significance of geometer Gerolamo Saccheri's (1667 – 1733) attempt at defending the fifth postulate, as Copi notes, is that he unknowingly proposed for the first time a logical solution to the problem of parallel lines, a solution that could lead beyond Euclidean geometry. Saccheri approached the problem by replacing this postulate with assumptions that were contrary to it. This method, known as a *reductio ad absurdum* proof, would attempt to demonstrate the fallacy of a proof that is based on assumptions that contradict the proposition that is being proved. If Saccheri were able to direct his proof from one step to the next, leading to an absurdity in the final statement, he would have proven by inference the validity of Euclid's fifth postulate that opposed the untenable statement of Saccheri's proof. According to Copi:

> [Saccheri] derived many theorems that he regarded as *absurd* because they were so different from common senses or ordinary geometrical intuition. He believed himself to have succeeded thus in demonstrating the parallel postulate, and in 'vindicating Euclid'. But his derived theorems, while 'absurd' in the sense of violating ordinary geometrical intuitions, were *not* 'absurd' in the logical or mathematical sense of being self-contradictory. (Copi 156)

Instead of defending Euclid as he thought, Saccheri's results achieved something more significant from a broader epistemological point of view: "he was the first to set up and develop a system of non-Euclidean geometry" (Copi 156). As I demonstrate in detail below, the challenge for many nineteenth-century geometers of reasserting the pre-eminence of Euclid's axiomatic method, thereby restabilizing the foundations of epistemology, is undermined finally by Gödel's 'inefficient' model of Undecidability on which Derrida draws for his own model of deconstruction.

Chapter One
7.) Synthesizing Reason and Experience

In some respects, I argue, the empiricist philosophy advanced by Immanuel Kant offers an early model for Kathryn Hayles' posthumanist approach that will be discussed below, despite significant differences in the scope of their writings. Like Hayles' posthumanism, Kant attempts to write bodily experience into his epistemology, contrasting his work with the rationalism constructed by Descartes and Leibniz. In fact, Hayles' challenge against Foucault's historicism is based on exactly this idea, that the *epistemic* shifts of history for Foucault take place apart from the liberal human subject, but also apart from a sense of human corporality (Hayles 194 - 199). Although Hayles directs her discussion toward the phenomenology of Merleau-Ponty as a response to Foucault (199), an earlier figure in this genealogy leading to her discussion of the coming integration of bodies and machines could include the empiricist work of Immanuel Kant. Kant's similar focus on human experience also shares Hayles' aspiration, which is finally untenable I argue, of creating an efficient machine both theoretical and physical, that functions 'impossibly' without wasting or requiring energy. Kantian empiricism relies on an increasingly indefensible Euclidean axiomatic geometry in the nineteenth-century as the engine for his philosophical machine (as Plotnitsky calls it in *R* 316). As my readings of technologies' relation with bodies in narratives such as *Blade Runner* and *Brazil* shows, however, the inefficient geometry of Gödelian Undecidability and the inefficient technology of *écriture* offer a more satisfactory porous model for the dissipating energies in this interrelation.

According to philosophers Susan Castagnetto and Stephen Korner, Immanuel Kant's reasons for writing *The Critique of Pure Reason* were at least two-fold: to respond to the empirical skepticism advanced by David Hume and to the pure mathematics advanced by Gottfried Leibniz. As had earlier philosophers, Kant drew on the received wisdom of his day, applying Euclidean geometry to a foundational part of his epistemology. Historically, his work in the nineteenth century just preceded that of mathematicians Cantor, Gauss and Riemann, who undermined the validity of Euclid's axiomatic method, and then developed geometries denying the postulates on which Euclidean geometry had been built. Thus the significance of an outmoded Euclidean method in Kant's philosophy is the subject of some debate, leading recent commentators such as Stephen Palmquist to address the question of whether "the 'satisfactory proof' Kant offers in the first *Critique* [is] inextricably tied to the necessary validity of Euclidean geometry, Aristotelian logic, and Newtonian physics, as is so often assumed?" (Palmquist). Palmquist's response, however, that Kant's philosophical system could include formal structures that are not necessarily Euclidean, does not detract from the significance that Euclid's geometry played in his philosophy. The significance of the Euclidean axiomatic method is shown through Kant's turn away from the analytic approaches of Descartes and Leibniz in favour of an empiricism that had been first advanced by Aristotle. As David Bostock notes, "rationalists such as Descartes stress the importance of mathematics for our understanding of the world, whereas Empiricists such as Locke and Berkeley . . . belittle it" (Bostock). Kantian empiricism, however, draws on the axiomatic method to provide the foundation for his attempts at integrating the thought processes of the mind with the experiences of the body.

Kant writes against the empiricism of Hume, who "attacked mathematics itself" (Bostock) because he claimed that its principles had no basis in human experience, and the rationalism of Leibniz, who viewed mathematics as primarily an exercise in logic (Korner 23). In place of empiricism and rationalism, Kant proposes to join the *a priori*, or analytic, philosophy of geometry with the synthetic, or empirical philosophy of geometry. Adding *a priori* conditions to a form of knowledge serves a specific purpose in Kant's philosophy. Through the *a priori* he hopes to resolve rationalist issues regarding the reliability of knowledge that is filtered through the senses. By adding the "synthetic" category to his structure of knowledge, he hopes to address questions relating to the applicability of philosophy to everyday experience. Kant would concede that *a priori* statements were trustworthy, because they did not require validation from sources outside of themselves. The weakness of relying only on *a priori* statements, however, was that they were therefore self-evident, and did not offer new information about the world. According to Kant, statements that are both *a priori* and synthetic can be found in only one field, that of the geometry compiled and systematized by Euclid.

To this end, he attempts to establish the validity of statements that are both synthetic and *a priori*, even though the two terms seem to exclude each other. Kant therefore begins his project with the assumption that all people possess mathematical knowledge, and that this innate knowledge is structured along the lines set out by Euclid in the *Elements*. Trudeau summarizes Kant's arguments in favour of the synthetic *a priori* nature of Euclidean geometry:

> 1.) Euclid's Postulates, Common Notions and Theorems are all *a priori*. (As we are confident that they are true, and no experimental test would increase our confidence, our judgment that they are true must not depend on extra-linguistic experience.)
>
> 2.) Euclid's Postulates are also synthetic. (This has been verified for at least one Postulate.)
>
> 3.) But the logical consequences of synthetic statements are synthetic.
>
> 4.) Every Theorem depends on the Postulates. (None is a consequence of the Common Notions alone.)

5.) Therefore Euclid's Theorems are all synthetic.

6.) Therefore Euclid's Theorems are synthetic a priori statements.

> Proof of their necessity (as *a priori*) is manifest in one's confusion when trying to imagine a non-Euclidean space. These proofs are synthetic because they rely on some other X to validate themselves. In this *X* Kant puts his doctrine of space, namely Euclid's theorems. (Trudeau 46)

In order to establish that Euclidean geometry is both *a priori* and synthetic, Kant has to set up a proof that re-admits empiricism into what had become, through the influence of Plato, Descartes and Leibniz, a paradigm for the effectiveness of pure rationalism.

Kant next attempts to establish how people acquire this mathematical knowledge. Gaining this mathematical knowledge, he proposes, takes place through a combination of analytic thought and synthetic experience. These two forms of knowledge, working together, organize people's understanding of their lived spaces. For Kant the laws of geometry are not simply analytic, as Descartes and Leibniz believed. Instead, Kant asks, how do people acquire geometric knowledge? They do so through their experience of space and of the objects in that space.

Kant outlines his reasons for considering Euclidean geometry to exemplify synthetic *a priori* reasoning in his *Critique*:

> We might, indeed, at first suppose that the proposition 7 + 5 = 12 is a merely analytic proposition, and follows by the principle of contradiction from the concept of a sum of 7 and 5. But if we look more closely we find that the concept of the sum of 7 and 5 contains nothing save the union of the two numbers into one, and in this no thought is being taken as to what that single number may

> be which combines both. The concept of 12 is by no means already thought in merely thinking this union of 7 and 5; and I may analyze my concept of such a possible sum as long as I please, still I shall never find the 12 in it. (Kant *Critique*)

According to Castagnetto, therefore, the concept of the sum of seven and five for Kant 'contains' nothing besides the "idea of their union in a single number – the particular number itself is not part of or contained in the thought" (Castagnetto 255). Kant attempts to further solidify his argument, by appealing to people's conceptions of geometric objects:

> Suppose a person is presented with the concept of a triangle and be left to find out, in his own way, what relation the sum of its angles bears to a right angle. He has nothing but the concept of a figure enclosed by three straight lines and possessing three angles. However long he meditates on this concept, he will never produce anything new. He can analyze and clarify the concept of a straight line or of an angle or the number three, but he can never arrive at any properties not contained already in these concepts. And furthermore, he will not discover through analysis that the sum of the interior angles of the triangle will equal 180 degrees. (Kant *Critique*)

Like his example of the sum of 12 from 5 and 7, Kant challenges the principles on which Cartesian and Leibnizian rationalism were founded, asserting that nothing in the concepts of the numbers in and of themselves would lead one to gain the further insight of the sum of either numbers or the angles of triangles.

Kant's further rebuttal against pure rationalism continues with a consideration of the ways in which people determine the validity of a mathematical concept. He states that instead of being able to draw firm conclusions based on reasoning alone, we proceed beyond the analytic concepts themselves. To convince ourselves of the truth of a concept we turn to some intuitive device to help us find a final determination:

> We have to go outside these concepts, and call in the aid of the intuition which corresponds to one of them, our five fingers, for instance, or, as Senger does in his *Arithmetic*, five points, adding to the concept of 7, unit by unit, the five given in intuition. For starting with the number 7, and for the concept of 5 calling in the aid of the fingers of my hand as intuition, I now add one by one to the number 7 the units which I previously took together to form the number 5, and with the aid of that figure [the hand] see the number 12 come into being. (Kant *Critique*)

Although earlier attempts by rationalists to place the axiomatic method on the grounds of reason, Kant's synthetic method, on the other hand, appeals to the faculty of intuition to demonstrate the veracity of his claims. Instead of undermining his theory as a result, Kant believes the presence of intuition in his proof validates its foundational status.

Realizing the significance of intuition for his system, Kant proceeds by qualifying what he means by the term. He suggests that when a person is to apprehend some experience of the outside world, he uses his "faculty of intuition," or his senses. Organizing that sensory input, determining the meaning of that experience takes place in another faculty apart from that of intuition, however. Kant calls this other, organizing faculty, the "faculty of understanding."

As we might imagine, Kant's appeal to intuition to explain one's experiences of the everyday world raises another difficulty of its own. If intuition is grounded in sensory experience, how could one realize that mathematical precepts are transcendental, above time and contingency? In Section 9 of the *Prolegomena*, Kant advances the following response:

> [M]y intuition [can] anticipate the actuality of the object, and be a cognition *a priori*, viz., if my intuition contain nothing but the form of sensibility, which in me as subject precedes all the actual impressions through which I am affected by objects. For that objects of sense can be intuited only according to this form of sensibility I can know a priori. Hence it follows that propositions which concern this form of sensuous intuition only are possible and valid for [all] objects of the senses; as also, conversely, that intuitions are possible a priori can never concern any other things than objects of our senses. (Kant *Prolegomena*)

Kant proposes to resolve the tension between historic contingency and transcendence by suggesting that intuition remains *a priori* because only the form of intuition, and not the content, carries this *a priori* status. Kant then describes his conception of intuitive form in relation to content:

> At the very least, the idea seems to be that the form or formal features of a particular type of thing are just those features which are necessary and universal for and, as such, are determinative of something being a thing of that type. In this sense, the form of an item is always prior to the instances of the item. There could be no instances without the form. This is, of course, not a temporal priority, but rather a logical or conceptual priority. (in Castagnetto 259)

For Kant, then, computing mathematical sums offers an example of the distinction between the form and content of intuitive knowledge. One does not think of the form of the calculation as influencing the final result. Instead we feel equally confident performing the addition on our fingers or on a calculator. For Kant, what is needed to complete a mathematical calculation is an appeal to some form that stands outside of the calculation itself. This form, for him, is the form taken by the faculty of intuition.

It follows, then, in Kant's terms, that the faculty of intuition does not only passively record the geometric forms of space, but that it also plays an active role, constructing these objects (Korner 28):

> . . . we will be able to explain the possibility of synthetic *a priori* knowledge in mathematics only if the mind is viewed as being itself the source of those (formal) conditions which must be met by anything that is to be represented as an object of intuition by such a mind (in Castagnello 260).

Kant's description of objects having an existence only in relation to our ability to perceive them through our faculty of intuition contrasts with Plato's description of the objects we perceive in the world, being the objects as they are. In contrast with Kant, Plato posits that ontology merges with epistemology. As Trudeau summarizes Plato's rationalist understanding of the world,

> Plato's philosophy is certainly very different from Kant's. Kant, with the experience of 2200 years of post-Platonic philosophers to draw on, gave up entirely the hope of knowing the world as it is and settled for a small collection of [precepts] about the world we experience. Plato naively (Kant would have said) identified the two – what we experience is the world as it is – but downgrading both, located complete reality only in the underlying World of forms, descriptions of which constituted Plato's much larger collection of [foundational truths]. (Trudeau 115)

In *The Republic* Plato asserts that geometry is the knowledge of what eternally exists (527B). Plato based his assertion not on Euclid's text, which was written later, but on another *Elements* that was written by someone else. We can see how Plato, like Kant, is not interested in proving the truth of geometric statements themselves. Instead he is more deeply interested in showing how geometric truths are discovered. Thus the epistemological status of the network of geometrical axioms that he reads in the *Elements* is never itself doubted. Plato assumes its validity and proceeds from there. Because of this assumption he can state that geometric axioms appear to be true because they are derived from the World of Forms, from which human, prenatal experience also derives.

Although Kant would disagree with Plato's strictly analytic approach to geometric Forms that exist in a noumenal sphere, he does take up Plato's idea of our memories of the realm of Forms. Kant counters Plato's strict rationalism by saying that this earlier realm of Forms offers the *X*, the space that accounts for the postulates' synthetic nature. This earlier prenatal experience of geometric forms in fact brings them down into the world of experience, while permitting them to retain their *a priori* quality. Thus, according to Trudeau, "Despite philosophical differences, Plato and Kant agree on the following: foundational truths about the world exist. Euclid's theorem is a foundational truth" (Trudeau 116). Since Kant asserts that only those objects that we can perceive are those that conform to the *a priori* structure of our intuitive faculty, we would be justified in asking about the nature of these intuitive objects as they exist in time and space. He answers by saying that if one were to remove all qualities from these objects, the most fundamental qualities that would remain, those that would still sustain them as objects, would be their qualities as members of time and space.

From here Kant feels that he needs to take only one final step before establishing the primacy of Euclidean geometry as an organizing paradigm for knowledge that is both *a priori* and synthetic. According to Kant, therefore, the principles of geometry hold true, not because they are analytically correct, but because they correctly represent the way we intuit objects in space. Castagnetto emphasizes how the relation between objects in space and the way they are perceived is formalized through Euclid's axiomatic system:

> No wonder then that any possible object of experience will — of necessity and without exception – accord with the formal properties of space and time as codified in pure mathematics. Consequently, we can never be – and, moreover, we may be assured *a priori* that we never will be – confronted in experience with counterexamples to the arithmetic and geometric judgments we establish *a priori* when doing mathematics. (Castagnetto 261)

Kant accepts that, since his views depend on the *a priori* formal conditions of the mind in order to perceive objects in time and space, his philosophy proposes a form of idealism. But with this concession, he also claims that his transcendental idealism allows him to assert that the objects we experience do not have any independent existence apart from that experience we have of them.

The link between Kantian empiricism and late twentieth-century debates about cybernetics and epistemology is important for my project here, not only because Kant's system represents the last to fully rely on Euclid's axiomatic system of geometry, but also because the idealist structure of Kantian philosophy paradoxically contradicts the synthetic process involved in his epistemology. As Foucault's reading of Kant's essay "What is Enlightenment?" demonstrates, this unresolved contradiction points ahead to the theorems of Gödel that formally prove the necessity of such paradoxes in any formal system, either abstract or concrete.

Although Foucault does not directly address the geometric structure that buttresses Kantian idealism, he does critique Kant's critique of pure reason at the point where Euclidean geometry performs its most significant work. Euclid's geometry provides a link between the transcendental, idealist realm and the synthetic, temporal and empiricist elements of his philosophy. For Kant, the fact that people intuitively experience space in the terms in which Euclid describes it is proof of its holding both *a priori* and synthetic qualities. Foucault's later essay, "What is Enlightenment?," takes its name from Kant's entry in a local essay-writing contest. The stakes in a question such as this, for transcendental philosophers such as Kant and later for Husserl, was not to define the content of Enlightenment knowledge *per se*. Instead they intended to describe the conditions that contributed to new knowledge entering the world. Implied in a question about origins were related questions regarding ends and means (teleology), about identity or being (ontology), and about the status of knowledge (epistemology).

According to Foucault, earlier philosophers had addressed questions about enlightenment in three ways that were distinct from Kant's approach, using Euclidean geometry as a framework for his attempt. First, according to Foucault, Enlightenment of a "present time" had been attached to descriptions of a particular era of history. "Thus," he writes, "in Plato's *Statesman* the interlocutors recognize that they belong to one of those revolutions of the world in which the world is turning backwards, with all the negative consequences that may ensue" (Foucault WIE). Secondly, the "present" era of Enlightenment could be understood as signaling a portentous event. Foucault finds the "historical hermeneutics" of Augustine to exemplify this "enlightenment as prognostication."

Finally, interpreters could read the "present" moments of enlightenment as demonstrating that a transition is already underway, leading from one era of human understanding to another.

> That is what Vico describes in the last chapter of *La Scienza Nuova*; what he sees 'today' is 'a complete humanity . . . spread abroad through all nations, for a few great monarchs rule over this world of peoples; it is also 'Europe . . . radiant with such humanity that it abound in all the good things that make for the happiness of human life'. (Foucault *WIE*)

Foucault states, however, that Kant responds to this question differently than these traditional approaches. Instead of "defin[ing] the internal teleology of a historical process," Kant defines "enlightenment" in more negative terms, as "*Ausgang*," or "escape." In this essay, Kant does not attempt to establish the transcendental structure of his idealist philosophy. Instead he chooses to focus on "contemporary reality" as it is experienced from day to day (Foucault *WIE*). In his essay Foucault discusses "three or four features that seem . . . important if we are to understand how Kant raised the philosophical question of the present day. Of these, the third interests us the most, since it raises issues relating to Kant's understanding of reason, which are directly supported by his insights regarding the foundational truth of Euclidean geometry" (Foucault *WIE*).

The distinction that Kant introduces in his discussion of duty and reason, that Foucault finds "surprising" in this context, is his distinction between reason that is public as opposed to reason that is private. According to Kant, people use private reason when they function simply as parts of a system, "when they have roles to play in society and jobs to do" (Foucault *WIE*). This use of reason helps people perform as useful members of society, subject to certain codes of conduct as they attempt to meet certain goals. Foucault states:

> Kant does not ask that people practice a blind and foolish obedience, but that they adapt the use they make of their reason to these determined circumstances; and reason must then be subjected to the particular ends in view. Thus there cannot be, here, any free use of reason. (Foucault *WIE*)

On the other hand, when people use their faculty of reason as an end of its own, as opposed to reasoning as a "cog in a machine" for some service to society, then their faculty of reason is "free and public." "Enlightenment," in Kant, does not prefer one of these faculties of reason over another. Instead "[t]here is Enlightenment when the universal, the free, and the public uses of reason are superimposed on one another" (Foucault *WIE*). The significance of this distinction for Foucault does not lie in the actual terms with which Kant proposes to describe the Enlightenment as *Ausgang*. Instead, Foucault focuses on the historically contingent fact that Kant makes this distinction between public and private reason, at this particular time. Foucault:

> Kant in fact describes the Enlightenment as the moment when humanity is going to put its own reason to use, since its role is that of defining the conditions under which the use of reason is legitimate in order to determine what can be known, what must be done, and what may be hoped . . . . The critique is, in a sense, the handbook of reason that has grown up in Enlightenment; and, conversely, the Enlightenment is the age of the critique. (Foucault *WIE*)

The contradiction in Kant's formulation pulls between his idea of people as historic agents who use their reason to determine the course of their lives, and people as passive participants in the course of history, over which they have no control. The contradiction between the transcendence of Kant's *a priori* idealism (structure) and his synthetic empiricism (process) finally remains unresolved.

Chapter One
8.) Leaving Euclidean Space

According to mathematician Douglas Hofstadter, the beginning of the end of Euclidean geometry's position as the apotheosis of rational principles begins with the desire, during the Victorian period, to mechanize thought processes. The irony of the fact that the attempts at mechanizing thought processes through the construction of 'thinking' or calculating machines should undermine the pre-eminence of Euclid's axiomatic system is found in the axiomatic system having been prized for centuries as an efficiently 'mechanical' model of logic. Once the rational processes represented in Euclid's logic are made increasingly rigorous, the porousness of what had been assumed to be airtight logic becomes increasingly apparent, leading to the proposal of non-Euclidean epistemological models. However, as I argue below, although many of these models rely on the machine as a metaphor, they no longer conceptualize the reasoning mechanism as operating with complete efficiency, but with waste, dissipation and entropy. Although the ability to reason has been commonly viewed as what distinguishes humans from other living beings, paradoxically this ability also can be seen as most closely aligning humans with another 'species', that of machines. Ironically, the aspiration to make thought processes efficient by deploying mechanical metaphors leads to mechanical models of reason that include inefficiency in their operations. As Hofstadter states,

> . . . our ability to reason has often been claimed to be what distinguishes us from other species; so it seems somewhat paradoxical, on first thought to mechanize what is most human. Yet even the ancient Greeks knew that reasoning is a patterned process, and is at least partially governed by statable laws. Aristotle codified syllogisms, and Euclid codified geometry; but thereafter, many

> centuries had to pass before progress in the study of axiomatic reasoning would take place again. (Hofstadter 19)

This desire to codify geometry according to non-Euclidean principles, derived from the discovery, initiated by Georg Cantor and refined by Bertrand Russell, that the concept of infinity embedded in the fifth postulate of Euclid's *Elements* was in fact impossible to resolve. At its core was an "antinomy" (in Russell's term). This antinomy derived from the contradiction of attempting to define the concept of infinity that by definition cannot be defined. Korner locates this difficulty within the terms that analytical philosophers themselves had used:

> One of the most important and fruitful events in the history of mathematical logic and the philosophy of mathematics was the discovery that Cantor's logic of classes, by admitting as a class any collection, however formed, leads to contradictions . . . . The path of deduction from logic to mathematics leads through this territory. Here it is where the followers of Leibniz, Frege and Russell are forced in order to cross from the one to the other, to make assumptions not 'obviously logical' – at least in the sense of 'logical' implied by Leibniz's, Frege's or Russell's use of the term. (Korner 44-45)

This formal proof that demonstrated the impossibility of proving a postulate, in turn led geometers of the nineteenth century to work in several directions.[6]

First, one of the directions in which some geometers worked derived from Gauss and Riemann's negative proof. Their formal demonstration that a proof for the fifth postulate was impossible to establish showed that it was possible to establish a proof that not only supported a postulate, but also that it was possible to establish a proof that showed its lack of validity. Second, another of the directions in which other geometers worked attempted to place Euclidean geometry in doubt. Prior to the nineteenth century, geometers had assumed that the *Elements* systematically described physical space as it was lived. When geometers such as Cantor systematically demonstrated that in fact the *Elements* had internal contradictions, mathematicians involved in questions regarding epistemology wondered "How could there be different kinds of 'points' and 'lines' in one single reality?" (Hofstadter 20). They therefore responded by attempting to clarify the meaning of "proof." Logicians such as George Boole began to codify patterns of reason more closely than had Aristotle, 'modestly' titling his subsequent book *The Laws of Thought.* The author and mathematician Lewis Carroll created many puzzles that applied these more rigorously formalized methods of reason. And the analytic philosopher, Bertrand Russell, building on the rationalist work of Gottlob Frege, also began to address the paradoxes that were surfacing with the renewed application of logic to a system that had seemed so logical at the beginning of the century.

Until this historical moment, geometers had simply assumed they had codified their systems according to what they thought was waterproof logic. This assumption can be demonstrated by examining, as does mathematician Ernest Nagel,[7] a typical proof that could be set up in the form of a *reductio ad absurdum* argument:

> Suppose, in contradiction to what the proof seeks to establish, that there is a greatest prime number. We designate it by 'x'. Then:
>
> 1. x is the greatest prime.
>
> 2. Form the product of all primes less than or equal to x, and add 1 to the product. This yields a new number y, where y = (2 X 3 X 5 X 7 X . . . Xx) +1
>
> 3. If y is itself a prime, then x is not the greatest prime, for y is obviously greater than x.

4. If y is composite (i.e., not a prime), then again x is not the greatest prime. For if y is composite, it must have a prime divisor z; and z must be different from each of the prime numbers 2, 3, 5, 7,. . ., x, smaller than or equal to x; hence z must be a prime greater than x

5. But y is either prime or composite

6. Hence x is not the greatest prime

7. There is no greatest prime

Nagel asserts that "It can be shown . . . that in forging the complete chain [of this proof] a fairly large number of tacitly accepted rules of inference, as well as theorems of logic, are essential" (Nagel 40). He continues:

> Look at line 5 of the proof. Where does it come from? The answer is, from the logical theorem (or necessary truth): 'Either p or non-p', where 'p' is called a sentential variable. But how do we get line 5 from this theorem? The answer is, by using the rule of inference known as the "Rule of Substitution for Sentential Variables," according to which a statement can be derived from another containing such variables by substituting any statement (in this case, 'y is prime') for each occurrence of a distinct variable (in this case, the variable 'p'). The use of these rules and logical theorems is, as we have said, frequently an all but unconscious action. And the analysis that exposes them, even in such relatively simple proofs as Euclid's, depends upon advances in logical theory made only within the past one hundred years. (Nagel 41)

As I noted at the beginning of this Chapter, Kant had said (in 1787) that Aristotle's logical system could not have been improved. But as Nagel points out, "The fact is that the traditional logic is seriously incomplete, and even fails to give an account of many principles of inference employed in quite elementary mathematical reasoning" (Nagel 40). The program, therefore, of resolving the logical structure of Euclidean geometry was given further refinement and expression in the mathematical logicism described in Bertrand Russell and Alfred North Whitehead's *Principia Mathematica*, published in 1910.

In this text, Russell and Whitehead attempt to show that all ideas that are expressed in mathematical terms can be also reduced to a more essential, logical state. Thus, for example, they determined that the square root of negative 1, which had previously been considered an imaginary number, instead should be defined as an ordered pair of integers (0,1)

> upon which certain operations of addition and multiplication are performed. Irrational numbers were also given their own classification based on a logical function. The square root of 2 was defined as a certain class of rational numbers – namely, the class of rationals whose square is less than 2. (Nagel 42)

Instead of considering mathematical entities to carry meanings, or content, or to have an ontology of some kind, Russell and Whitehead sought to represent them only in terms of their logical function. In this way, *Principia Mathematica* seemed to have improved the possibility of establishing the grounds for internal consistency within a geometric paradigm. If logic was consistent, then so too would be a geometric proof. Nagel:

> *Principia Mathematica* thus appeared to advance the final solution of the problem of consistency of mathematical systems, and of arithmetic in particular, by reducing the problem to that of the consistency of formal logic itself. For, if the axioms of arithmetic are simply transcriptions of theorems in logic, the question whether the axioms are consistent is equivalent to the question whether the fundamental axioms of logic are consistent. (Nagel 43)

Although this system initially seems to succeed, if one were to ask whether this system could ensure that all antinomies would be excluded from its processes, a final answer could not be provided. Instead the problem that Russell and Whitehead sought to resolve only emerges in a more generalized form, more broadly related to the practice of logic itself, to which their system is attached. Although they were not able to finally resolve the possibility of paradox in geometric proofs, the attempt to do so did succeed in

> creating the essential instrument for investigating the entire system of arithmetic as an uninterpreted calculus—that is, as a system of meaningless marks, whose formulas (or 'strings') are combined and transformed in accordance with stated rules of operation. (Nagel 44)

Russell discovered that the way the contradiction worked, in Euclid's fifth postulate, and in Cantor's set theory, was through a confusion of classes. He proposed to avoid Cantor's paradox by clarifying the sets of objects that could potentially include themselves as a member of their own class. The self-referential "loop" began operating, Russell discovered, when the set could be included as a member of its own class. To close this "strange loop" (as Hofstadter calls it), Russell proposes the following:

> A class will be called 'normal' if, and only if, it does not contain itself as a member; otherwise it will be called 'non-normal'. For example, a normal class, in Russell's terms, would be represented in a set of English students, since the set itself could not be included in its own category. However, if we were to consider a set of all ideas that were subject to thought, the set itself can be included as a member of the objects that it identifies, and thus becomes a 'non-normal' set. Based on these assumptions, Russell states the paradox: Let "N" by definition stand for the class of all normal classes. We ask

> whether N itself is a normal class. If N is normal, it is a member of itself (for by definition a class that contains itself is a member of itself (for by definition N contains all normal classes); but, in that case, N is non-normal, because by definition a class that contains itself as a member is non-normal. On the other hand, if N is non-normal, it is a member of itself (by definition of non-normal); but, in that case, N is normal, because by definition the members of N are normal classes. In short, N is normal if, and only if, N is non-normal. It follows that the statement "N is normal" is both true and false. This fatal contradiction results from an uncritical use of the apparently pellucid notion of class. (Nagel 24)

Principia Mathematica initially seemed to circumvent the destructive pattern of self-referentiality in set theory, and by extension, in their entire axiomatic, though non-Euclidean system. Their system also seemed to show that it was possible to construct a set of geometric postulates that were based on logic alone, and avoid the "strange loops" of self-reference that had been unavoidable in other systems.

Instead of assuming that the postulates of a geometric system were valid because they represented the planes and volumes of lived space, for geometers like Russell and Whitehead who were attempting to create sound geometric systems based on only the principles of reason, the fundamental consideration was that of consistency. As Morris Kline writes:

> The discovery of the paradoxes of set theory and the realization that similar paradoxes might be present, though as yet undetected, in the existing classical mathematics, caused mathematicians to take seriously the problem of consistency. (Kline 216)

For example, after Gauss and his student Riemann, together with the Russians Bolyai and Lobachevsky, conclusively showed that it was impossible to deduce

Euclid's parallel axiom from the others, geometers instead attempted to establish the internal consistency of their non-Euclidean geometries. Thus, as Hofstadter states with reference to Russell's logicism, " . . . the methods given were even self-consistent. Was it absolutely clear that contradictory results could never be derived, by any mathematicians whatsoever, following the methods of Russell and Whitehead?" (Hofstadter 23). After he published his work with Alfred North Whitehead in *Principia Mathematica*, some mathematicians realized that their theory was too weak to resolve many different paradoxes. For others, Russell's type theory was too narrow in its scope because it prevented some otherwise valid statements from standing, because they violated the vicious circle principle that Russell had set out to block. On a broader level, geometers attempting to construct a non-Euclidean system were still faced with the challenge of maintaining internal consistency. How could they get around the fact that although all of their work up to that point had proven to be self-consistent, an internal paradox would not surface that would bring the whole project to a halt? We could consider Georg Riemann's attempt to prevent this destructive event.

Riemann proposes a geometric model that outright contradicts Euclid, assuming that *no* parallel lines can be drawn through a point alongside another line. How does Riemann establish the consistency of his geometric structure? If he relied solely on his own geometry, his system would be constantly at risk. In order to establish a non-Euclidean geometry, therefore, geometers such as Riemann looked to an external geometric model, much as Euclidean geometry had looked to external space to intuitively support its assertions. Although Riemann's geometry demonstrated that Euclidean geometry was in doubt, it nonetheless relied on the Euclidean model to support its own consistency. Nagel and Newman describe how this method was supposed to work:

The procedure goes something like this. Let us understand by the word "class" a collection or aggregate of distinguishable elements, each of which is called a member of the class. Thus, the class of prime numbers less than 10 is the collection whose members are 2, 3, 5, and 7. Suppose the following set of postulates concerning two classes K and L, whose special nature is left undetermined except as 'implicitly' defined by the postulates:

1. Any two members of K are contained in just one member of L.
2. No member of K is contained in more than two members of L.
3. The members of K are not all contained in a single member of L.
4. Any two members of L contain just one member of K.
5. No member of L contains more than two members of K.

From this small set we can derive, by using customary rules of inference, a number of theorems. For example, it can be shown that K contains just three members. But is the set consistent, so that mutually contradictory theorems can never be derived from it? The question can be answered readily with the help of the following model:

Let K be the class of points consisting of the vertices of a triangle, and L the class of lines made up of its sides; and let us understand the phrase 'member of K is contained in a member of L' to mean that a point which is a vertex lies on a line which is a side. Each of the five abstract postulates is then converted into a true statement. For instance, the first postulate asserts that any two points which are vertices of the triangle lie on just on line which is a side. In this way the set of postulates is proved to be consistent. (Nagel 16, 17)

Accordingly, Riemann established his non-Euclidean proof using a similar, fundamental set of postulates. In Riemann's axioms, the terms 'plane' 'point' 'straight line' are still used, but they are assumed to rest not on a flat planar surface, but on a spherical one. Thus, Riemann appears to have established his proof regarding the impossibility of parallel lines running through a single point. Riemann's geometry would be proved, except that no part of his methodology derives from its own independent structure. Instead it relies on the stability of Euclidean geometry. If the principles of Euclidean geometry remain sound, and the fifth postulate of parallel lines is not proven to be actually false (a further step beyond its being doubted), then Riemann's geometry also remains sound.

Initially relying on Euclidean geometry seemed to be a reasonable approach to proving the non-exclusivity of Euclidean geometry. As Nagel states, " . . . hallowed by a long tradition, the Euclidean axioms [had been accepted as] true and therefore consistent" (Nagel 18). Nagel and Newman are no doubt correct in stating that the Euclidean geometry on which Riemann had built his own, non-Euclidean axioms has been shown not to be foundational. However, one irony that they do not pursue is that Riemann's model of space as negatively curved, as noted above, provides the description of space that Einstein used for his theory of relativity.

Another response to the paradox that Cantor's set theory opened up in axiomatic reasoning focussed on the form of geometric propositions, instead of the logic as Whitehead and Russell proposed. This formalist approach was proposed by David Hilbert. Unlike Russell and Riemann, Hilbert proposed that mathematical postulates be separated from their content, leaving only their forms. The work of nineteenth century geometers such as Cantor had shown that the *Elements* relied on more axioms than Euclid had actually written down. In 1899 Hilbert therefore proposed to fill in those gaps, and to produce a complete axiomatic system that would resolve Euclid's fifth postulate, as well as the other paradoxes of self-referentiality in geometric reasoning that were surfacing.

This axiomatizing of geometry that Hilbert proposed to undertake countered the initial approach of Euclid, who believed that for a geometric theorem to hold, it needed to be self-evident in the physical world. Like the other geometers proposing a non-Euclidean geometry, Hilbert's program of axiomatization attempted to establish the possibility of geometry as an internally consistent system, not based on an experience of the world but on the principles of sound reasoning. As Ross writes, "Formalists seek to express mathematics as strictly formal logical systems, and to study them as such, without concern for their meaning" (Ross). The only meanings in Hilbert's system are those assigned to them by their "formation-rules" in the system. These "formation-rules" regulate how they combine into well-formed axioms. As might be expected, however, the logicist Russell objects to Hilbert's formalism because it reduces mathematics to a "'game with meaningless marks'. His method does not take into account the simplest functions of numbers, even that of counting in arithmetic" (in Nagel 41).

Russell's criticism of formalism was not entirely accurate, however. Hilbert's Program had a modest, "finitist" goal of formalizing only a part of geometry's axioms. To avoid paradoxes that arose through unexamined assumptions regarding infinity, Hilbert did indeed propose to construct a system that emptied all meaning out of the objects of that system. What remained were just a collection of "meaningless marks" that were organized according to a carefully established set of rules. However, emptying geometric symbols of meaning was more than just a "game" to Hilbert. He thought that by setting up a formalist system in this way, he could gain greater control over the content of geometric propositions. He could prevent metaphysical meanings about the ontology of geometric objects from accidentally entering his system. Instead, by constructing a system that was comprised only of signs, he could avoid appropriating "any unavowed principles of reasoning" (Nagel 27).

Among the undefined (or "primitive") terms that Hilbert uses in his formalization of geometry are 'point', 'line', 'lies on', and 'between'. Since he does not define these terms, we can assume that they mean what they usually do in the context of geometry. Since the meanings may be familiar, people may feel that they already understand their various relations with other axioms. This assumption, according to Hilbert, influences the geometers as they formulate axioms on the way to establishing a proof. As well, the very familiarity of these primitive terms suggests and helps facilitate the formulation of the theorems. However, for Hilbert, to the degree that people are concerned with the mathematical task of exploring the logical relations of dependence between statements, they should try to ignore the familiar connotations of the primitive terms. The only "meanings" that should accrue to these terms are those that are associated with them through their relation with axioms. Perhaps Russell had Hilbert's Program in mind, therefore, when he stated (at least the saying is attributed to him): "pure mathematics is the subject in which we do not know what we are talking about, or whether what we are saying is true" (Russell in Nagel 31).

Although Hilbert attempted to construct a formalized system that did not express any content, he nonetheless thought that at least his formalist structure demonstrated the possibility of an axiomatic system held together by its own principles, avoiding the antinomies that Euclidean geometry inadvertently generated. The shell of formal signs that remained on a page were called 'strings' in Hilbert's system. These strings showed the relation of one set of theorems to another, how they were dependent on each other and were combined. From these strings one could make statements about the functions and relations of these strings.

But because these formalized strings of geometric procedures were themselves empty of meaning, it would not follow that the statements one could make *about* their relations (which *would* on some level be meaningful) were themselves a part of the formalist system. According to Hilbert, these statements that were *about* the formal strings belonged to another class that he called "meta-mathematics." Meta-mathematical statements, according to Hilbert,

> are statements about the signs occurring within a formalized mathematical system (i.e., a calculus) – about the kinds and arrangements of such signs when they are combined to form longer strings of marks called "formulas," or about the relations between formulas that may obtain as a consequence of the rules of manipulation specified for them. (in Nagel 28)

For example, if we consider the mathematical expression 2 + 2 = 4 we see that this statement comprises only mathematical objects from elementary arithmetic. On the other hand, if we say, "2 + 2 = 4" is a mathematical statement, then we have made an assertion about the original statement. This assertion, in Hilbert's formal system, does not belong to the same class of mathematical statements as does the first, but belongs in the class of meta-mathematics. The distinction between the two statements lies in the fact that the first derives from the discipline of mathematics itself and the second, on the other hand, derives from a discourse about the discipline of mathematics. According to Nagel and Newman,

> It is worth noting that the meta-mathematical statements given in the text do not contain as constituent parts of themselves any of the mathematical signs and formulas that appear in the example. At first glance this assertion seems palpably untrue, for the signs and

> formulas are plainly visible. But, if the statements are examined with an analytic eye, it will be seen that the point is well taken. The meta-mathematical statements contain the names of certain arithmetical expressions, but not the arithmetical expressions themselves. The distinction is subtle but both valid and important. It arises out of the circumstance that the rules of English grammar require that no sentence literally contains the objects to which the expressions in the sentence may refer, but only the names of such objects. Obviously, when we talk about a city we do not put the city itself into a sentence, but only the name of the city; and, similarly, if we wish to say something about a word (or other linguistic sign), it is not the word itself (or the sign) that can appear in the sentence, but only a name for the word (or sign). According to a standard convention we construct a name for a linguistic expressions by placing single quotation marks around it. Our text adheres to this convention. It is correct to write: Chicago is a populous city. But it is incorrect to write: Chicago is tri-syllabic. To express what is intended by this latter sentence, one must write: 'Chicago' is tri-syllabic. Likewise, it is incorrect to write: x = 5 is an equation. We must, instead, formulate our intent by "'x = 5' is an equation." (Nagel 30, 31)

For Hilbert, the paradoxes that had risen in past geometric proofs had done so because of a confusion between the form of the geometric proof and the meta-mathematical language that ascribed meaning to that form. Hilbert's solution was to rigorously separate the structure of mathematical statements from their apparent meanings.

Furthermore, Hilbert's program side-stepped the paradox of infinity by proscribing infinite concepts or values from its formulations. Hilbert's model was thus called "finitistic," because it attempted to achieve internal consistency with only a "minimum of principles of inference" (Nagel 33). Proofs, therefore, constructed according to this finitist principle were (perhaps optimistically) called "absolute." Thus, according to Nagel, an absolute proof, if one could be constructed ultimately, would demonstrate simply that two equal and opposite formulas (such as '0 = 0' and its negation '~(0 = 0)' where '~' means "not," cannot both be produced from the same rules of inference from the same initial axioms.

Nagel and Newman illustrate this role of meta-mathematics in establishing finitist proofs by turning to the game of chess. The 32 chess pieces are moved around a board of 64 coloured squares according to an agreed upon set of rules. This set of rules does not have any point of reference beyond the game board, and the chess pieces that each player moves around. Likewise, the chess pieces themselves do not have any intrinsic symbolic meanings attached to themselves either. Although they are given the names of a medieval feudal system, the King, Queen, Knight, Bishop and so on, do not represent people who held those offices at that particular time. As Nagel asserts: "In this sense, the pieces and their configurations on the board are 'meaningless.' Thus the game is analogous to a formalized mathematical calculus" (Nagel 34, 35). He continues:

> The pieces and the squares of the board correspond to the elementary signs of the calculus; the legal positions of pieces on the board, to the formulas of the calculus; the initial positions of pieces on the board, to the axioms or initial formulas of the calculus; the subsequent positions of pieces on the board, to formulas derived from the axioms . . . and the rules of the game, to the rules of inference (or derivations) for the calculus . . . Although

> configurations, like the formulas of the calculus, are "meaningless," statements about these configurations, like meta-mathematical statements about formulas, are quite meaningful. (Nagel 35)

To continue the chess analogy, the kind of statements that one would make, for example, when evaluating Kasparov vs. IBM's computer, Blue, would involve only a finite number of possible statements since only a finite number of moves would be possible. Hilbert's Program had a similar goal: to show that within a certain sphere of mathematical reasoning it would be possible to establish proofs that did not simultaneously generate contradictory statements that undercut its initial postulate. Hilbert believed that by limiting the scope of his geometry, he could avoid the paradoxes that had surfaced because Euclid's initial postulate had assumed space to be infinite, and a consistent plane at infinity. For others attempting to establish systems on the basis of internal consistency, the infinity problem nonetheless still arose because they had been attempting to establish finite proofs with an infinite number of mathematical objects. Hilbert, by contrast, recognized that when a proof is established, it holds true only for the number of objects included in its string of theorems. In order for the proof to bear weight, however, most other mathematicians would tentatively assume that the proof would remain true no matter what magnitude of objects would be included in its set.

Besides Russell's logicism, and Hilbert's formalism, a third response to the paradox of infinity was proposed by L. E. J. Brouwer. The geometry that Brouwer proposed differed significantly from both Russell's logicism and Hilbert's formalism. Beginning with his doctoral thesis (1907), Brouwer posited an intuitionist argument to counter that of logicism and formalism. As Bostock states: "Against formalism, then, he sees no merit in formal systems without true 'content', and against logicism he believes that mathematics is prior to logic, and does not need it" (Bostock). A basic tenet of Brouwer's intuitionism, therefore, rejects the "Principle of the Excluded Middle," which states that mathematical statements are either true or false. Brouwer's approach thus showed daring, since ruling out the Principle of the Excluded Middle also meant ruling out a logical technique with a very long tradition, the *reductio ad absurdum*. Thus in 1918 Brouwer published a set theory, in 1919 a measure theory and in 1923 a theory of functions, all without using the Principle of the Excluded Middle (O'Connor). Although Brouwer made major contributions to the field of topology, he never offered courses in topology, despite a teaching position at Amsterdam. According to a student,

> It seemed that he was no longer convinced of his results in topology because they were not correct from the point of view of intuitionism, and he judged everything he had done before, his greatest output, false according to his philosophy. (O'Connor)

Brouwer's philosophy of mathematical intuitionism reconstructs the principles of epistemological idealism and Kantian metaphysics. He therefore rejected the idea that mathematics was based on an expressive logical language. To him, logic only organized various stages of mathematical reasoning that had already been processed and complete. Brouwer's philosophy instead was founded on his sense that "there are no inexperienced truths and that mathematical objects stem from the *a priori* form of those conscious acts which generate empirical objects" (Posy 468). For intuitionists, therefore, the most fundamental mathematical act one can perform is that of distinguishing between diverse elements as one's consciousness flows. This distinguishing practice in turn generates the natural numbers, arithmetical operations and thus the rational numbers (Posy 468).

The difficulty with the intuitionist system, however, arose out of conceptions of the line, as it had for other approaches to epistemology in geometry. The continuous action of distinguishing between different elements, which was considered to be the characteristic of the intuitionist approach, does not account for the line's linear flow. Brouwer attempted to resolve this problem twice. The first attempt stipulated that the geometer needs an intuition of an ever-expanding continuum. This first attempt was similar to Aristotle's description of a continuum that could be expanded through a potential infinity that added one more element after the next, in a process that was never to be complete. Since this method went against his own model of set-theory, however, Brouwer replaced this approach with another concept, that of an "infinite choice sequence." A choice sequence, of $n + 1^{st}$ choices, for example, is governed by a rule to some degree. The presence of this rule would thus inhibit the continuity of the sequence, thus allowing some room in Brouwer's model for the determination of successive elements.

Chapter One
9.) Undecidability in Geometric Reasoning

> "Uber formal unentscheidbare Satze der Principia Mathematica und verwandter Systeme" (*On Formally Undecidable Propositions of Principia Mathematica and Related Systems*)
>
> When Harvard University awarded Gödel an honorary degree in 1952, the citation described this work as one of the most important advances in logic in modern times.

According to Gödel's theorems (1931), a formula that can neither be proved nor disproved exists in any formal system that contains natural numbers derived from the axiomatic method. Gödel's theorem demonstrated that it is impossible to prove the consistency of a system from within the system itself, thus undermining Russell and Whitehead's logicist project, since they were attempting to construct a consistent mathematical system from only a few axioms. Similarly, Gödel's theorem applied pressure to Hilbert's formalist Program. Hilbert's attempt at demonstrating the consistency of mathematics by limiting his focus to the forms of mathematical propositions, instead of their content, was also rendered untenable for the most part, because only the formal system itself was permitted to generate mathematical objects and restricted definitions for those objects.[8] These attempts at making the rational process more stringent through the mechanization of logical steps ironically contribute to Gödel's oppositional formulation, which states that these processes will always function inefficiently, similar to Derrida's concept of *écriture* as a 'productively' wasteful technology.

As was discussed above, the idea that a proposition may be established through a set of axioms begins with the ancient Greeks, who attempted to formalize and standardize the reasoning process into a recognizable proof. However, their axiomatic method requires one to accept without proof certain propositions as axioms or postulates (for example, the axiom that one straight line can be drawn through two points). Then one is to derive from these axioms all other propositions of the system as theorems. Generations of geometers never questioned the validity of this practice, since Euclidean geometry appeared to be reflected in lived space.

Thus, while demonstrating the limitations of this rational practice, one of the paradoxical results of Gödel's proof is its reinforcement of Platonist (that is, analytical) philosophy. Gödel's method is itself rational, based on the foremost necessity of *a priori* reasoning to discover mathematical principles, even those that cannot be finally resolved. Gödel in fact demonstrates that mathematics simply draws logical conclusions from sets of axioms or postulates, but that none of these conclusions can be granted foundational epistemological status. As Nagel describes this more recent appeal to internal consistency in establishing a geometric proof:

> It came to be acknowledged that the validity of a mathematical inference in no sense depends upon any special meaning that may be associated with the terms or expressions contained in the postulates.
>
> The postulates of any branch of demonstrative mathematics are not inherently about space, quantity, apples, angles, or budgets; and any special meaning that may be associated with the terms (or "descriptive predicates") in the postulates plays no essential role in the process of deriving theorems . . . the sole question confronting the pure mathematician (as distinct from the scientist who employs mathematics in investigating a special subject matter) is not whether the postulates he assumes or the conclusions he deduces from them are true, but whether the alleged conclusions are in fact the

> necessary logical consequences of the initial assumptions. (Nagel 14)

Gödel's paper described both the mathematical actions as well as the meta-mathematical statements that describe those actions in numbers, and strings of numbers that were themselves assigned number tags. These numbers were called Gödel's numbers, since they arithmetized all the levels of mathematical expression, not only the level of the formulas.

The detailed expository section of Gödel's theorem that follows lays the groundwork for the discussion of how deconstruction operates, in light of Derrida's several claims regarding the relation of deconstruction and Gödelian geometry in a later section of this Chapter, as well as in Chapters Two and Three where I take up the relevance of this operation for Foucault's conception of the *episteme* and Hayles's conception of posthumanism. Indeed, this description of Undecidability provides a template for reading the undecidable connection of technology and biology in Chapter Four and Chapter Five's studies of *Blade Runner* and *Brazil.* Gödel's numbers are assigned from out of a class of elementary signs, known as either the "constant signs" or the "variables" (Nagel 69). We can follow Nagel's and Newman's adaptation of Gödel's method by beginning with ten elementary signs that belong to the class of the "constant." These are as follows: "~" represents "not;" "V" represents "or"; sideways "U" represents "if . . .then . . ."; "=" represents "equals"; "0" is the numeral for the number zero. Gödel uses three signs of punctuation: the left parenthesis "("; the right parenthesis ")"; and the comma ",". Besides these, the system uses an inverted letter "E" to represent the phrase "there is" which emerges in "existential quantifiers"; the system also uses a lower-case "s" which represents the immediate successor of the number to which it is attached. For example: (Ex)(x=s0) could be read to mean: "There is an x such that x is the immediate successor of 0."

Alongside the constant signs, Gödel's system uses three different kinds of variables. The first class is called "numerical variables" and is designated by 'x', 'y', and 'z', substituting numbers and numeric values with these letters. The second class, "sentential variables," are assigned the letters 'p', 'q', and 'r'. These letters as well can represent formulas or strings of mathematical procedures. Finally, Gödel's system uses predicate variables that receive the letters 'P', 'Q', and 'R', replacing these letters with predicate statements about numeric values (such as 'prime', or 'less than'). The operation of each of these variables is performed within rules that Gödel carefully defines.

Thus, Gödel assigns each of these Constant Signs and Variables a separate number:

<u>Constant Signs</u>

~	1	not
V	2	or
Sideways U	3	If . . . then . . .
Inverted E	4	There is an . . .
=	5	equals
0	6	zero
s	7	The immediate successor of
(	8	punctuation mark
)	9	punctuation mark
,	10	punctuation mark

<u>Numerical Variables</u>

X	11	0
Y	13	s0
Z	17	y

(numerical variables are associated with prime numbers greater than 10.)

<u>Sentential Variable</u>

P	11^2	0=0
Q	13^2	(Ex)(x=sy)
R	17^2	pUq

(Sentential Variables are associated with the squares of prime numbers greater than 10.)

Predicate Variable

P	11^3	Prime
Q	13^3	Composite
R	17^3	Greater than

(Predicate Variables are associated with the cubes of prime numbers greater than 10.)

Gödel's Undecidability theorems work as follows. One can consider a formula that expresses the fact that every number has a number that follows it presumably into infinity. This formula would look like this: (Ex)(x = sy). (There is an x such that x is the immediate successor of y.)

If we assign Gödel numbers to this formula the scheme works as follows:

(E x) (x = s y)

8 4 11 9 8 11 5 7 13 9

Instead of using a string of numbers each time to refer to this formula, it is simpler to refer to a single number instead. We can do this by using each of the Gödel numbers as powers that are attached to the primes that rise in order of sequence. Thus, the sequence of numbers above would be given the following number:

$2^8 \text{ X } 3^4 \text{ X } 5^{11} \text{ X } 7^9 \text{ X } 11^8 \text{ X } 13^{11} \text{ X } 17^5 \text{ X } 19^7 \text{ X } 23^{13} \text{ X } 29^9 \ldots$

The result of this formula we could designate with the letter '*m*'. This number which we would substitute for the letter '*m*' if we cared what it actually was, always represents our initial formula (Ex)(x = sy). Without providing further examples, we can see that every mathematical formula in Gödel's system could be assigned a number that would refer back to each of the steps that had been taken to arrive at that number. Ironically, Nagel's summary draws attention to the close relation of Gödel's methodology for formally proving the 'inefficiency' of a formal proof with that of Leibniz who proposes a similar methodology for efficiently establishing a formal proof:

> The method is essentially a set of directions for setting up a one-to-one correspondence between the expressions in the calculus and a certain subset of the integers. Once an expression is given, the Gödel number uniquely corresponding to it can be calculated. (Nagel 74)

Gödel's system, of reading back from a given number to determine if it is a Gödel number, can be read through the following table:

A	243,000,000
B	64 X 243 X 15,625
C	2^6 X 3^5 X 5^6
D	6 ->0 5 ->= 6 ->0
E	0 = 0

"The arithmetical formula 'zero equals zero' has the Gödel number 243 million. Reading from A to E, the illustration shows how the number is translated into the expression it represents; reading up, how the number for the formula is derived" (Nagel 76).[9] Using this method, Gödel discovered that the formal proof paradoxically will always produce numbers and terms that contradict the terms of the proof itself but cannot be proved or disproved without recourse outside the structure of the proof. As I show in the next section, Derrida refers to the formal proof of Gödel's logical paradox as a model for the productively inefficient operations of deconstruction at several important points throughout his career.

Chapter One
10.) Deconstruction and Geometry

"The Double Session" itself can be read as doubled session, a transcription from a talk that Derrida gave on transcriptions and talks. The editor's introduction to *Dissemination* emphasizes the significance of un-synthesized doublings, or paradoxical contradictions for Derrida's inefficient interpretive machine, deconstruction:

> The title ("The Double Session") has been proposed by the editors. For reasons that will become clear in the reading, this text did not present itself under any title. It formed the occasion for two sessions (February 26 and March 5, 1969) of the *Groupe d'Études théoriques*. The reader should also know that at that time only the first part of "La Dissémination" had been published (*Critique*, no. 261, February 1969).
>
> Each participant had been handed a sheet on which a passage from Plato's *Philebus* (38e-39e) and Mallarmé's *Mimique* (Pleiade, p. 310) had been printed . . . Is it pointless to add that a blackboard stood covered with a series of framed and numbered quotations? And that the room was lighted by a sumptuous, old-

fashioned lustre? (Editor's note)" (173 *Dissemination* published in Paris under the title *La Dissémination* 1972; U of Chicago P, 1981.)

Derrida refers to Gödel's theorem while discussing Mallarmé's use of the word "allusion." In contrast with "illusion," he states that allusion in *Mimique* functions independently of an axis of truth/falsehood. Instead, allusion plays with meaning, and does so according to "that operation we are here by *analogy* calling undecidable" (Derrida *D* 219). The playfulness that allusion performs, which Derrida calls "undecidable," exemplifies the intentional inefficiency of meaning transfer that I argue characterizes Derridean deconstruction. To offer a clearer (less playful) understanding of the term "undecidable," Derrida qualifies it: "An undecidable proposition, as Gödel demonstrated in 1931, is a proposition which, given a system of axioms governing a multiplicity, is neither an analytical nor deductive consequence of those axioms, nor in contradiction with them, neither true nor false with respect to those axioms. *Tertium datur*, without synthesis" (Derrida *D* 219). Derrida invokes Gödel's theorem to show an "operation," a syntactical operation that precludes the classical, dialectical synthesis that the philosophies of Kant, Leibniz and Descartes had attempted.[10]

Central to my dissertation's argument regarding the interrelated effects of geometry, epistemology and cybernetics, Gödelian undecidability, for Derrida, operates inefficiently in the field of geometry similar to the way that deconstruction operates inefficiently in the field of language, where *écriture* describes the paradoxical contradictions embedded in terms that had been located in a metaphysics of voice. In his discussion of the contrast between the ideologies of writing and of speech, Derrida places Plato (*Philebus*) and Mallarmé (*Mimique*) at opposite ends of this tradition. "The history of this relationship," Derrida writes, "would be organized by – I won't say mimesis, a notion one should not hasten to translate (especially by imitation), but by a certain interpretation of mimesis" (Derrida *D* 183). For Derrida, Mallarmé's experiments with written language "coincide with [the] disappearance" of the logic that prioritized voice over pen. Although Derrida is reluctant to consider this history as a whole, with its own meaning intact, he does assert that the very conditions of meaning creation within this history have been contingent on the assumption that the spoken voice represented a metaphysics of presence that deconstruction attempts to pry apart.

"The Double Session" of the title, thus, refers to the contrasting readings of Plato's *Philebus* and Mallarmé's *Mimique* that Derrida proposes to conduct. These readings are important for my project because they demonstrate the way Derrida puts Gödelian undecidability to play in a textual context, outside of its original field of numbers. According to Derrida, Plato's *Philebus* tells the story of the history of meaning, of epistemology, a history that was constructed on the assumptions that epistemology could be foundational, and that epistemology had a recognizable origin and teleology. Derrida outlines the ways the *Philebus*, then, emphasizes four aspects of this history of meaning through its interpretation of the book and the book's relation to voice.

First, the book functions as a dialectic that substitutes for the speaking voice, and that despite this distance, permits a resolution of the speaking voice that is represented by the writing on the page. In the *Philebus*, "the metaphorical book thus has all the characteristics that, until Mallarmé, have always been assigned to the book, however these might have been belied by literary practice. The book, then, stands as a substitute for dialogue, as it calls itself, as it calls itself alive" (Derrida *D* 185). This substitute dialogue sounds itself silently in the interior of the reader, taking the place of the more fundamental condition that would be represented by a conversation with the actual author.

Secondly, according to Derrida, the *Philebus* demonstrates that "The truth of the book is decidable" (Derrida *D* 185). In the *Philebus*, the writer always only writes within a matrix that has two poles, that of truth and of falsehood. The importance of the book is assessed according to its alignment with truth: "It is only worth its weight in truth, and truth is its sole standard of measurement. It is through recourse to the truth of that which is, of things as such, that one can always decide whether writing is or is not true, whether it is in conformity or in "opposition" to the true" (Derrida *D* 185). In contrast to Mallarmé's writing practice, the written word in Plato aspires to this metaphysical condition of truth, because its sole function is to 'truthfully' represent speech, the origin of language.

Thus, thirdly, "the value of the book is not intrinsic to it." The book that the *Philebus* describes only borrows its influence from the voice that it is transcribing on the page. In this sense, the book records an original moment that has always already taken place. In Derrida's reading of Plato, "The book, which copies, reproduces, imitates living discourse, is worth only as much as that discourse is worth" (Derrida *D* 186). The printed word, therefore, is comprised of dead letters, letters that do not benefit from a vitality that is their own. Since the metaphysical depths of language are located in the interior of the speaker, from whose depths the words issue forth, whatever energy or ability to convince they may have is borrowed only from this speaking moment that has come before.

Fourth, since writing exists in this relation with voice, a relation that is always derivative and anterior to it, the "element of the thus characterized book," for Derrida, "is the image in general, the imaginary or the imaginal" (Derrida *D* 186). Since the spoken word announces the presence of an interior, and of a soul for Socrates, the written word by extension serves as an image of that soul, whose meanings it merely transcribes. The book only reproduces the spoken word, "and the whole is organized by this relation of repetition, resemblance, doubling, duplication, this sort of specular process and play of reflections where things, speech, and writing come to repeat and mirror each other" (Derrida *D* 188). This collusion between the representative function of both the writing and the image, explains why, in the *Philebus*, painting and writing are allied with each other. Both representational systems freeze the dynamic qualities of the soul that are expressed without mediation in the voice. Thus, Derrida argues, only a reading (or spoken interpretation) of both the text and the painting can re-animate the otherwise dead figures of speech and of paint. The *logos* that interprets art, in consequence, offers that art its only justification and public function. "It is worth only as much as the *logos* capable of interpreting it, of reading it, of saying what it is-trying-to-say and what in truth it is being made to say through the reanimation that makes it speak" (Derrida *D* 189). In view of the constant, primary, presence of the soul as expressed through the spoken voice, Derrida argues that Platonism finally

> decides and maintains . . . precisely the *ontological*, the presumed possibility of a discourse about what is, the deciding and decidable *logos* of or about the *on* (being-present). That which is, the being-present (the matrix-form of substance, of reality, of the oppositions between matter and form, essence and existence, objectivity and subjectivity, etc.) is distinguished from the appearance of the image, the phenomenon etc., that is, from anything that, presenting it *as* being-present, double it, re-presents it, and can therefore replace and de-present it. (Derrida *D* 191)

For Derrida, Platonic metaphysics also undermines the "flesh and blood" concepts of the phenomenologists, for whom technologies, such as writing, interfered with the subject's immediate (unmediated) experience of the life-world. Derrida concludes this section, "Discernability, at least numerical discernability, between the imitator and the imitated is what constitutes order. And obviously, according to 'logic' itself according to a profound synonym, what is imitated is more real, more essential, more true, etc., than what imitates. It is anterior and superior to it" (Derrida *D* 196). The function of writing in the *Philebus* is always in the ancillary position, following and reflecting the truer auditory presence that has preceded it.

By contrast, Derrida turns to the second part of the double session, and invites his listeners to read a sentence near the centre of a page that he handed out to them at the beginning of the session. Even though the sentence is placed in quotation marks, he tells them, it is not a citation from another source, but instead plays with the possibility of citation, a "simulacrum of citation or explicitation" (Derrida *D* 195). The sentence in question reads: "'The scene illustrates but the idea, not any actual action . . .'" (Derrida *D* 195). Derrida begins his reading of this sentence, by calling it a "trap," a temptation to perform the kind of classical interpretation that Plato invited in the *Philebus*. In this sense, the "scene" that is doing the "illustrating" would be in the position of representing or imitating (to *image*) an abstraction, an idea, instead of an "actual action." The mime who is the subject of Mallarmé's text would still be imitating some more fundamental ground, even though that ground consists of abstraction, an idea instead of an action.

> One would then say: of course the mime does not imitate any actual thing or action, any reality that is already given in the world, existing before and outside his own sphere; he doesn't have to conform, with an eye toward verisimilitude, to some real or external model, to some nature . . . In this sense, whether one conceive it in its 'Cartesian' or in its 'Hegelian' modification, the idea is the presence

> of what is, and we aren't yet out of Platonism. It is still a matter of imitating . . . an *eidos* or idea, whether it is a figure of the thing itself, as in Plato, a subjective representation, as in Descartes, or both, as in Hegel. (Derrida *D* 196)

However tempting this interpretation, Derrida would instead suggest that reading Mallarmé should not be carried out within an index of "concepts or words" similar to those Plato attempted to fix in place. Instead, he states, "one must reconstitute a chain in motion, the effects of a network and the play of a syntax" (Derrida *D* 197). Instead of discovering an inverted idealism in Mallarmé, that reinscribes a Platonic metaphysics, reading within this reconstituted field of play locates "the lustre" of his text in a "completely other place."

Thus the mime in Mallarmé's text paradoxically mimes nothing. In Derrida's reading, Mallarmé constructs this figure in such a way that no other ground precedes him, to which he could become the figure: "There is nothing prior to the writing of his gestures." This lack of any other priority of course precludes the possibility of a speaking voice (such as Mallarmé's, the author's) having given a metaphysical present to his being (*ontos*). But further, the lack of any *other* priority gives the mime in Mallarmé's text a chronological priority as well, to the degree that priority even has significance here. "No present has preceded or supervised the tracing of writing. [The mime's] movements form a figure that no speech anticipates or accompanies. They are not linked with logos in any order of consequence" (Derrida *D* 194 -195). The paradoxical status of the mime (having a beginning without origin; a being without ontology), permits Derrida to conduct a reading that deconstructs the metaphysics of origin and ontology that structured Plato's *Philebus*.

In contrast with the imitative relation of the written word to the spoken in Plato, the written word in Mallarmé is itself constitutive, though without reference to an outside that imbues it with meaning. In Mallarmé's text, the Mime "always plays out a difference without reference, or rather without a referent, without any absolute exteriority, and hence, without any inside" (Derrida *D* 219). This reference to the Mime figure in Mallarmé's text as playing without reference to an "absolute exteriority" leads Derrida to Gödel's undecidability theorems, since this play allusively resists synthesis in any metaphysical presence.

In Derrida's analogic application of Gödelian undecidability, the mime mimes not in relation to an authoritative metaphysical presence that exists outside and lends him life. Instead, the mime mimes "a game conforming only to [his] own formal rules." The allusiveness of the mime's play is organized by a "system of axioms," but those axioms of themselves are not sufficient to explain, through logic, all of the movements that are conducted by the mime. The fact that these movements cannot all be synthesized into one metaphysical system, as Plato would have it, is not a weakness of that system, in Mallarmé's, and Gödel's, terms, but an expression of the condition of formal structures of all kinds, metaphysical or otherwise.

To take up Derrida's terms, because the description of the mime playing without referent outside of the text may tempt one to assume that his deconstructive reading would be open to any interpretation whatsoever, Derrida attempts to describe more specifically what he means by "undecidability" outside of its mathematical context.

> 'Undecidability' is not caused here by some enigmatic equivocality, some inexhaustible ambivalence of a word in a "natural" language . . . . What counts here is not the lexical richness, the semantic infiniteness of a word or concept, its depth or breadth, the sedimentation that has reproduced inside it two contradictory layers of signification (continuity and discontinuity, inside and outside,

> identity and difference, etc.). What counts here is the formal or syntactical *praxis* that composes and decomposes it . . . What holds for 'hymen' also holds . . . for all other signs which, like *pharmakon*, supplément, *différance*, and others, have a double, contradictory, undecidable value that always derives from their syntax, whether the latter is in a sense "internal" articulating and combining under the same yoke two incompatible meanings, or "external," dependent on the code in which the word is made to function. But the syntactical composition and decomposition of a sign renders this alternative between internal and external inoperative. (Derrida *D* 220 – 221)

The fact that the undecidable terms which Derrida lists above do not work alongside an outside referent does not suggest that they could ultimately become unified within another set of syntactical rules. Instead, Derrida states, "they mark the spots of what can never be can never be mediated, sublated, or dialecticized through an (Hegelian) *Erinnerung* or *Aufhebung* . . . These 'words' admit into their games both contradiction and noncontradiction" (Derrida *D* 221).

Ten years earlier, in *Edmund Husserl's Origin of Geometry: An Introduction by Jacques Derrida* (1962), Derrida likewise puts Gödel's theorems to work against the metaphysical assumptions of classical philosophy, but in this text he gives the theorems a valence that differs from his earlier application of them. His introduction shows how Husserl's interest in describing the emergence of new geometric concepts draws broadly on Kantian formalism. Some of these concepts include *deciding* the degree to which the features of new geometric discoveries are pre-determined, deciding the degree to which these discoveries are created from within a thinking mind and deciding to what degree they are actually discovered as independent entities.

However, another, perhaps more significant aspect of Husserl's discussion of new concepts in geometry centres on Husserl's understanding of "origins" and by extension, of history. Husserl asserts that, when considering the epistemological implications of an origin in geometry, he does not consider himself to be thinking as a geometer himself would think. For this geometry, in fact, the question of the origins of his discipline has little relevance to his practice of geometry. The practicing geometer instead inherits a glossary of geometric terms that enable him to perform actual geometric calculations, and perhaps discover new applications. As Husserl states:

> There is no need for [the question of the origin] in the attitude of the geometer: one has, after all, studied a geometry, one 'understands' geometrical concepts and propositions, is familiar with methods of operation as ways of dealing with precisely defined structures. (Husserl *OG* 34)

The practice of geometry requires familiarity with its concepts and propositions. This familiarity prevents the geometer from considering the origins of his discipline.

However, according to Derrida, three difficulties emerge as a result of Husserl's formulation of a phenomenological reduction of a history of geometry to its origins. Briefly, these include the discovery that the "sense of the origin" of geometry would in fact still elude the phenomenologist thinking about the facts of this origin (Derrida EH 35); that the actual geometrical nature of these first geometrical acts would still have eluded Husserl's phenomenologist (Derrida EH 37); and, that the discernment of what in fact were the first geometric actions at the advent of geometry would still not present themselves to the phenomenologist (Derrida *EH* 37ff). By contrast, Derrida more favourably introduces Kant's conception of origins as a historic *process* instead of the work of a cognizant philosopher. Derrida writes:

> No doubt, once the geometrical concept has revealed its freedom with respect to empirical sensibility, the synthesis of the "construction" is irreducible. And indeed it is an ideal history. But it is the history of an operation, and not of a founding. It unfolds explicative gestures in the space of a possibility already open to the geometer. The moment geometry is established as such, the moment, that is, something can be said of it, then geometry already will be on the point of being revealed to the consciousness of the first geometer, who is not, as in the *Origin*, protogeometer, the primally instituting geometer. (Derrida *EH* 41)

Husserl's confidence in the presence of a first geometer who discovers the first geometrical concepts leads him to posit, furthermore, that the tradition of geometry which follows from this initiation is a unified one.

The sense of geometry as whole, and as maintaining strict boundaries between its in- and out-sides, enables him to feel justified in initiating a "return inquiry" into the "being" of geometry's origins. Husserl:

> If science, with radical responsibility, has reached decisions, they can impress on life habitual norms as volitional bents, as pre-delineated forms within which the individual decisions ought in any case to confine themselves, and can confine themselves so far as those universal decisions have become actually appropriated. For a rational practice, theory *a priori* can be only a delimiting form; it can only plant fences, the crossing of which indicates absurdity or aberration. (Husserl *F* 6)

Husserl's assertion regarding the unity of geometry's sense of itself as a whole tradition thus leads to Derrida's invocation of Gödel's theorem.

That invocation derives from Derrida's note that geometry bases its sense of unity, for Husserl, not on "a general concept that is extracted or abstracted from various known geometries. On the contrary it is the primordial concrete essence of geometry that makes such a generalizing operation possible" (Derrida *EH* 52). However, Derrida does not want us to confuse this "concrete essence of geometry" with a further concept, "that Husserl in fact determines is the ideal orienting geometrical practice in geometry's objective thematic field" (Derrida *EH* 52 - 53). For Husserl this orienting geometric practice is to be found in the axiomatic system itself, which for him offers a "definite nomology and an exhaustive deductivity." For Husserl, as for the classical philosophers who precede him, this axiomatic system of geometry is irreducible: "Starting from a system of axioms which 'governs' a multiplicity, every proposition is determinable either as analytic consequence or as analytic contradiction. That would be an alternative we could not get beyond" (Derrida *EH* 53). We recognize that Husserl's assumptions regarding the logical outcome of axiomatic reasoning follow the precepts of Euclidean, and by extension, of Kantian *a priori* synthetic formalism. However, Derrida writes, "Such confidence did not have long to wait before being contradicted: indeed its vulnerability has been well shown, particularly when Gödel discovered the rich possibility of "undecidable" propositions in 1931" (Derrida *EH* 53). Husserl shows that his thinking remained uninfluenced by developments in mathematical philosophy through his confidence in the decidable nature of geometric axioms. As he states in *Formal and Transcendental Logic*:

> The idea of a "nomological science," or correlatively the idea of an infinite province (in mathematico-logical parlance, a multiplicity)

> governable by an explanatory nomology, includes the idea that there is no truth about such a province that is not deducibly included in the fundamental laws of the corresponding nomological science – just as, in the ideal Euclid, there is no truth about space that is not deducibly included in the 'complete' (*vollstandigen*) system of space-axioms. Such a multiplicity-form is defined, not by just any formal axiom-system, but by a complete one. The axiom-system formally defining such a multiplicity is distinguished by the circumstance that any proposition (proposition-form, naturally) that can be constructed, in accordance with the grammar of pure logic, out of the concepts (concept-forms) occurring in that system, is either 'true' – that is to say: an analytic (purely deducible) consequence of the axioms – or 'false' – that is to say an analytic contradiction --; *tertium non datur.* (Husserl *F* 96)

As Derrida notes, the decidable condition of axiomatic propositions, which Husserl assumes ground geometric investigations, are themselves the method that Husserl would use to discover this ground, thus catching him in a tautology, the "vicious circle" of reasoning, of which he remains unaware (Derrida *EH* 55-56).

Derrida's third reference to Gödel's undecidability theorems occurs in an interview with Gerald Graff, and is reproduced as an introduction to *Limited Inc* (1988). His reference to Gödel's theorems, here, serves a purpose that contrasts with his earlier references to them in "The Double Session," and in the *Introduction to Husserl's Origin of Geometry*. In the earlier two texts, Gödel's theorems modeled an operation that deconstructed the metaphysical presence of spoken language. In this interview, on the other hand, Derrida draws on Gödel's theorems to *stabilize* the semantic play of meanings in his project of deconstruction. According to his response to Graff, he intends to distinguish this more stable operation of meaning production from more indeterminate (non-) models, such as those proposed metaphorically by Niels Bohr in the field of quantum mechanics. I quote both the question and response at length here to provide a fuller context for the stakes that both acknowledge are involved with this issue. Graff:

> In *Of Grammatology*, you make it clear that you do not deny the ability of interpreters, for certain purposes, to reproduce a so-called literal meaning of a text. You say that the 'moment of doubling commentary should no doubt have its place in a critical reading,' and that without 'this indispensable guardrail' . . . 'critical production would risk developing in any direction at all and authorize itself to say almost anything' (p. 158).
>
> Could you comment on how this issue of the possibility of a 'doubling commentary' may bear on an assertion like the following in *Limited Inc* . . . "in breaching and dividing the self-presence of intention, iterability "leaves us no choice but to mean (to say) something that is (already, always, also) other than what we mean (to say) . . ." (62). If this process of intentions and meanings differing from themselves does not negate the possibility of "doubling commentary," then are its practical implications for interpretation perhaps not so threatening to conventional modes of reading as has been thought – or, perhaps I should ask, are they threatening in a different way than has been thought?
>
> I raise this question not to suggest that the self-divided nature of meaning has no practical consequences for interpretation, but to ask whether those consequences are best described in terms of undecidability and indeterminacy. I ask this from a sense that, in

> the United States at least, the controversy over your work has often become caught up in somewhat unprofitable disputes over whether words can mean anything determinate (i.e., whether your work eliminates all 'guardrails')—something which it seems you've never denied. A possible result is that more interesting issues you have raised have tended to be overlooked, such as those having to do with your view that meaning is often based on acts of exclusion and repression which leave their traces on it. At least in focusing almost entirely on the issue of determinate reading vs. undecidability, the popular criticisms of your work seem hardly to recognize this latter issue, which has to do with the way discourse inscribes power relations.
>
> Of course those who believe in determinate meaning tend to ignore the ways discourse inscribes power relations, but could not one argue that those ways can themselves be quite determinate? In other words, would there not be some advantages for the moment anyway in separating the issue of whether meaning is structured by rhetorical coercion from the issue of whether meaning is determinate? (Derrida LI 142 - 143)

After reviewing his reading of Rousseau's "contracts" in *Of Grammatology*, Derrida continues his response to Graff by stating that his reading of Rousseau consists

> not of semantic structures that are absolutely anchored, ahistorical or transtextual, monolithic or self-identical . . . but of stratifications that are already differential and of a very great stability with regard to the relations of forces and all the hierarchies or hegemonies they suppose or put into practice. For example, the French language (its

> grammar and vocabulary), the rhetorical uses of this language in the society and in the literary code of the epoch, etc., but also a whole set of assurances that grant a minimum of intelligibility to whatever we can tell ourselves about these things today or to whatever part of them I can render intelligible, for example in *Of Grammatology* with whatever limited success. At stake is always a set of determinate and finite possibilities .
>
> Without a solid competence in this domain, the most venturesome interpretations of *Of Grammatology* would have been neither possible nor intelligible, nor even subject to discussion. What must be understood is not what this or that French word means to say naturally or absolutely, beyond all possible equivocation, but rather, first, what interpretations are probabilistically dominant and conventionally acknowledged to grant access to what Rousseau thought he meant and to what readers for the most part thought they could understand, in order, second, to analyze the play or relative indetermination that was able to open the space of my interpretation, for example, that of the word *supplément* . . . Otherwise, one could indeed say just anything at all and I have never accepted saying, or encouraging others to say, just anything at all, nor have I argued for indeterminacy as such. (Derrida LI 144-145)

Later in the interview Derrida emphasizes his intention to draw on undecidability as a model for deconstruction instead of indeterminacy:

> I do not believe I have ever spoken of "indeterminacy," whether in regard to "meaning" or anything else. Undecidability is something else again. While referring to what I have said above and elsewhere,

> I want to recall that undecidability is always a *determinate* oscillation between possibilities . . . These possibilities are themselves highly *determined* in strictly *defined* situations (for example, discursive – syntactical or rhetorical – but also political, ethical, etc.). They are *pragmatically* determined. The analyses that I have devoted to undecidability concern just these determinations and these definitions, not at all some vague "indeterminacy." I say "undecidability" rather than "indeterminacy" because I am interested more in relations of force, in differences of force, in everything that allows, precisely, determinations in given situations to be stabilized through a decision of writing (in the broad sense I give to this word, which also includes political action and experience in general). There would be no indecision or *double bind* were it not between *determined* (semantic, ethical, political) poles, which are upon occasion terrible necessary and always irreplaceably singular. Which is to say that from the point of view of semantics, but also of ethics and politics, "deconstruction" should never lead either to relativism or to any sort of indeterminism. (Derrida LI 148)

Derrida's assertion that deconstruction describes "relations of force" recalls the broad terms of Foucault's discourses on power. And through this association, Derrida begins to align the practice of deconstruction, modeled on Gödel's undecidability theorems, with political action:

> The words "force" and "power" which I have just joined you in using, also pose, as you can well imagine, enormous problems. I never resort to these words without a sense of uneasiness, even if I believe myself obligated to use them in order to designate something irreducible. What worries me is that in them which

> resembles an obscure substance that could, in a discourse, give rise to a zone of obscurantism and of dogmatism. Even if, as Foucault seems to suggest, one no longer speaks of Power with a capital P, but of a scattered multiplicity of micro-powers, the question remains of knowing what the unity of signification is that still permits us to call these decentralized and heterogeneous microphenomena 'powers'. For my part, without being able to go much further here, I do not believe that one should agree to speak of 'force' or of 'power' except under three conditions, at least. (Derrida LI 149)

The three conditions that Derrida goes on to name, then, do appear to admit a certain amount of indeterminacy in the play of forces: "there is never any thing called power, but only differences of power; the ostensibly greater force can also be the lesser; all the paradoxes and ruses of force [should] be taken into account" (Derrida *LI* 149). However the increased openness that Derrida seems to prefer here is vitiated somewhat by his earlier comments that do indeed attempt to put "guardrails" on the play of indeterminacy with an undecidable model. If we link a machinic metaphor to Derridean deconstruction, this abstract technology for reading texts accepts that entropy will result from homo-phonic textual approaches, that the energy of readings that attempt to retain a metaphysics of presence will begin to dissipate. In the sense in which Derrida deploys Gödel's theorems, Undecidability itself could be considered a 'machine' that functions inefficiently, preventing one final statement of proof from finally offering the epistemological stability that geometers had sought.

Plotnitsky's *Complementarity: Anti-Epistemology After Bohr and Derrida* thoroughly discusses and evaluates the philosophical implications of Derrida's decision to align deconstruction with the more epistemologically "efficient" model of Gödelian undecidability, rather than with Bohr's more radically "inefficient" (anti-) model of indeterminacy. Both "models" give some shape to the fuzzy boundaries of anti-epistemology, but undecidability, with its Gödelian influence, restricts its movement to doubling, where a semantic contradiction is hidden in a word that is apparently unified in meaning, and ostensibly carries a full, metaphysical presence implied in classical interpretations of "voice."

Although Derrida relies on Gödel's Undecidability theorems, it would be incorrect to assume that Gödel himself would align himself with Derrida's use of undecidability as an anti-epistemological model. Thus Plotnitsky asserts that "the concept of undecidability can be applied only by analogy and metaphorically outside the field of mathematical logic" (Plotnitsky C 208). Derrida draws on the analogous and metaphoric relation of undecidability outside of the field of mathematical logic for his own purposes, which are distinct from those of Gödel himself. In contrast to Derrida's anti-metaphysical aims, Gödel considered himself to be a Platonist. Plotnitsky states: "Gödel's own philosophy of mathematics was fundamentally metaphysical – a form of Platonism. In this sense, even as he discovers undecidability he remains a classicist . . . While, then, metaphorically associating Derrida's project with Gödelian undecidability, the present analysis in no way implies the identity or even similarity of Gödel's and Derrida's philosophical positions, which must be juxtaposed. In view of the proximities between Husserl's (who was, next to Leibniz, Gödel's favorite philosopher) and Gödel's philosophical views, one could pursue a deconstruction of Gödel's philosophy analogous to Derrida's deconstruction of Husserl" (Plotnitsky C 200).

In light of the distinctions that Plotnitsky draws between the degree of determinacy in Gödelian undecidability, and the high degree of indeterminacy in Bohr's quantum mechanical (non-)model, one recognizes that the discussion which philosopher Kelley L. Ross conducts, linking Kantian phenomenology with a philosophy of quantum mechanics, in fact confuses Gödelian "undecidable propositions" with "paradoxes of undecidability in quantum mechanics." Instead of clarifying some of the terms of a relationship between an anti-epistemological model like Derridean deconstruction, and an epistemological model like Kantian idealism, Ross instead muddies his discussion by confusing the two models of Gödel's undecidability and of Bohr's indeterminacy. Ross begins: "In general, quantum mechanics posits an interdependence between internal and external, knowledge and reality, that leaves us with paradoxical questions about how things can be real and independent of knowledge and at the same time be depend (*sic*) on the conditions of our knowing" (Ross). He does not follow up this simple statement with a thorough consideration of the high degree of indeterminacy that Bohr posits in quantum mechanics and the complicated ways they might engage with Kant's idealism. The "paradoxical questions" to which Ross refers instead belong to the more epistemologically stable model of undecidability, as Gödel formally demonstrated. Although he attempts to situate his reading of Kant in relation to Bohr's motto ("*Contrari non contradictoria sed complementa sunt*; "opposites are not contradictories but complements"), Ross nonetheless, inadvertently it would seem, locates his reading of Kant in a more determinate, dualistic environment: "that is where the analogy with the wave-particle duality is the strongest" (Ross). He has confused the degrees of instability represented in Gödel's undecidability (more closely linked to a dualistic environment) and Bohr's indeterminacy (of which wave-particle theory is a highly indeterminate non-model).

In a paper that does not investigate the implications of Euclidean geometry on Kantian idealism, Ross instead attempts to place the rationalism and empiricism of Kant's philosophy within a superficially investigated quantum mechanical model. The discussion fails to acknowledge both the anti-epistemological aims of indeterminacy in Bohr's quantum mechanical model as well as the epistemological aims of Kant's phenomenology. Nor does his discussion engage with the differing epistemological (Gödel/Platonic; Bohr/anti-Platonic) aims of the undecidable and indeterminate models. In fact, Bohr's project attempts to demonstrate the impossibility of establishing anything vaguely resembling epistemological foundations. Kant, on the other hand, through Euclidean axiomatics, attempts to establish the possibility of epistemological foundations for all time. These confusions, therefore, unfortunately influence Ross's concluding remarks. He erroneously asks: "is undecidability merely a limitation on our knowledge? Or does it reflect, as it is reasonable to ask about quantum uncertainty, some truth in which there is no indecision and no uncertainty?" (Ross). In fact, quantum mechanics does not even claim its own "indecision" as a truth. Plotnitsky's own concluding comments distinguishing Gödel's theorems in Derrida from Bohr's quantum mechanics, helps clean some of the fuzz from Ross's logic.

> As Derrida argues, we cannot make a claim upon an underlying structure of reading, writing, theory, or history; which also means that we cannot claim any structure — undecidable, indeterminate, or complementary – as unconditionally underlying or controlling them. Hence we also cannot claim that any given mode or style is irreducible, be it deconstructive, complementary, or both, or any other. One may, however, encounter local, which may also mean broadly ranged, and locally irreducible determinations – such as those necessitated by undecidability, indeterminacy, or complementarity. (Plotnitsky *C* 223)

Although one would wish to exercise greater care when invoking undecidable and indeterminate models, as Ross does, the risk one encounters when narrowly invoking the one model is of re-introducing a metaphysics of presence, an epistemological efficiency that Derridean deconstruction attempts to dismantle. To take up the terms of this dissertation that I introduced in the Preface, Derrida's model of deconstruction conducts interpretive operations, like a machine or mechanism. For Derrida, however, the waste, or loss of energy that results from the operation of this machine is limited to the fluctuation of two contradictory meanings for a term. Plotnitsky explains Derrida's position, that the results of constructing an interpretive machine that was completely inefficient would be as impossible to operate as constructing a completely efficient interpretive machine had been: "While no machine and no construction is possible without waste, however, a *machine* or an economy of absolute waste would be just as impossible, since it would require resources as infinite as Hegel's *Geist*" (Plotnitsky 300). As I argue in this dissertation, the non-productive weakness of Hayles's conception of posthumanism, as celebrating the complete fusion of humans and technology, avoids a satisfactory response to the question of waste that would complicate this relation, as indeed it does in the movies *Blade Runner* and *Brazil*.

Chapter Two

Gödelian Undecidability and the Word: Deconstructing an *Episteme*

In postulating the deconstruction of a Foucauldian *episteme* I am not attempting to initiate a discussion about the lexical richness of words, as Derrida cautions in his references to Gödelian geometry in "The Double Session." Instead I attempt to discover the undecidable 'mechanism' that operates within a term that is productive for Foucauldian thought, specifically as it relates to the "singularities" of cultural formations which he called the *episteme*. Attempting to deconstruct an *episteme* potentially runs into at least two dangers. On the one hand, if one were able to demonstrate how the mechanism of undecidability might work through one *episteme*, one should not risk extrapolating this success into all further theoretical contexts, that ultimately deconstruction equates with Foucauldian discourse theory. In fact all that will have been shown is the possibility of deconstruction functioning in this *one* instance of Foucauldian thought, and that imperfectly. To declare that both theories were completely compatible would re-locate them back in a metaphysical mode of completion, wholeness, giving their work an organicity and teleology that both Derrida and Foucault were writing against. Mapping deconstruction onto an *episteme* would also, I think, run the further risk of enabling their work to be made equivalent, thus stating that Derrida was finally interested in the thresholds of history, and that Foucault was ultimately interested in the excesses of language. These equivalencies would detract from the fruitfulness and richness of the engagement between their two projects.

Fundamental differences do indeed separate the work of Derrida and Foucault, as is exemplified through their contrasting approaches to the concept of mechanism. For example, as I discuss in greater detail in Chapter Five, Foucault's deployment of Jeremy Bentham's 'Panopticon' describes a disciplinary technology that operates consistently and efficiently in opposition to a potentially unruly prison population. By contrast, Derrida's application of the technological metaphor precludes any mechanisms, social or physical, from operating efficiently because technology is always constructed from individual parts. In Derrida's application, the interrelation between disciplinary technology and the populations that are available for this discipline further suggests the difficulty of constructing a model of perfectly functioning policing techniques. Indeed, a brief consideration of the etymology of the term "police" shows that it, together with terms such as "policy," and "politics," all derive from the early Greek term for the city, that of the *polis*. Although one could, following Foucault, suggest that the *Oxford English Dictionary's* definition of *polis*, "A Greek city-state; *spec.* such a state considered in its ideal form," shows how disciplinary structures completely infuse the ideal city, one could also draw the opposite inference from the close relation between the terms for "city" and the way it operates. Following Derrida one could argue that the transfer of value also flows from the chaotic masses of the *polis* back to the regulators, to the police and politicians. To some degree the rule of law is tempered by the will of the population that is policed by that law.

The distinction between Foucault's and Derrida's approaches to the concept of mechanism is illustrated by Derrida's discussion of writing as a technique that fragments holistic models like those proposed by Foucault. In *Margins of Philosophy* he opposes the spirit/presence represented in the voice with the mathematico/technological construction represented in writing. Here he deconstructs Hegel's 'spirit of history' that gathers force as it moves teleologically through time:

> In assigning the limits of so-called universal writing, that is, a mute writing, released from the voice and from every natural language,

> Hegel also criticizes the pretensions of mathematical symbolism and of arithmetic, the operations of formal understanding . . . If the passage through mathematical abstraction, through formal understanding, spacing, exteriority and death . . . is a necessary passage (for Hegel), this necessity becomes perversion and regression as soon as it is taken as a philosophical model.
>
> This is the attitude inaugurated by Pythagoras. And when Leibniz seems to permit himself to be impressed by the Chinese characteristic, he is only rejoining the Pythagorian tradition: 'As we know, Pythagoras represented rational relationships (or *philosophemata*) by numbers; and more recently, too, numbers and forms of their relations, such as powers and so on, have been employed in philosophy for the purpose of regulating thoughts or expressing them.' (Hegel's *Science of Logic*)
>
> The preface to the *Phenomenology of Spirit* had posited the equivalence of understanding, formality, the mathematical, the negative, exteriority, and death . . . Now, calculation, the machine, and mute writing belong to the same system of equivalences, and their work possess the same problem: at the moment when meaning is lost, when thought is opposed to its other, when spirit is absent from itself, is the result of the operation certain? . . . . If we consider the machine along with the entire system of equivalences just recalled, we may risk the following proposition: what Hegel, the relevant interpreter of the entire history of philosophy, could never think is a machine that would work. (Derrida *MP* 106 - 107)

Like Plato, Hegel located the fullness of the spirit of history (or *Geist*) in the vital sound of the speaking voice, instead of in the dead (silent) scratching of a hand operating the technology of a pen. As Plotnitsky argues: "Hegel would no doubt have resisted, in the strongest terms, conceiving of *Geist* as a machine – and not without reason. One needs an excess of "the machine" in the economy of matter, interpretation, memory, consciousness and the unconscious, theory, history, or politics" (Plotnitsky *R* 312).

The excess of the machine, to which Plotnitsky refers, is an excess of energy that the machine, both metaphoric and concrete, requires to constantly operate. The fact that no *perpetuum mobile* was ever discovered (the Royal Academy of Sciences (1775) "resolved, this year to examine no longer any solution to problems on the following subjects: the duplication of the cube, the trisection of the angle; and quadrature of the circle, or any machine claiming to be a perpetuum mobile" in Plotnitsky *R* 304), appears to lend credence to Hegel's metaphoric model of *Geist* as the historical force that is somehow never spent. However, it is against Hegel's non-mechanical efficiency that Derrida applies the writing machine since finally, for Derrida, the machine as construct instead of transcendent, as comprised of parts instead of organically whole, as requiring energy instead of perpetually moving, is irreducible in contrast with Hegel's *Geist*. Plotnitsky argues for the irreducible presence of technology in writing in Derrida:

> Somewhere between matter and the unconscious, between metaphor and technology, between history and play, *writing* becomes possible; and it becomes possible to inscribe, obliquely, some of the more complex effects of this expanded *différance*.
>
> Once *writing*, condemned throughout the history of philosophy as *techne* – an auxiliary technique, becomes irreducible, so does technology. Hence, this perspective generates a very different view of technology – as *writing* programs, hardware and software. Technology – as *writing* – poses a very different question,

> the question of *writing* or records that come 'before' the 'originals.' Or there emerges a play where all 'befores' and 'afters' must be re-played, re-inscribed, although, in certain sequences, the classical forms of 'origin' will have to be preserved . . . (his italics) (Plotnitsky *R* 315)

The lack of complete synthesis in the technological metaphor of *écriture* leads Derrida to oppose Plato's speech to Mallarmé's writing in "The Double Session," as he opposes Hegel's *Geist* to "the question concerning technology."

Although Derrida counters the metaphysical systems initiated by Plato with the metaphoric machine, technology has a metaphysics of its own that also needs to be deconstructed before it can be deployed: "If the theory of cybernetics is by itself to oust all metaphysical concepts – including the concepts of soul, of life, of value, of choice, of memory – which until recently served to separate the machine from man, it must conserve the notion of writing, trace, *gramme* [written mark], or grapheme, until its own historico-metaphysical character is also exposed" (Derrida *OG* 9). As I contend in the following chapter, Hayles's rehearsal of the three waves of cybernetic developments leads to her assertions regarding the value of the posthuman model that she attempts to advance. However, while her model does benefit from its closer links of technology and bodies, it nonetheless perpetuates the restricted economics of these previous approaches, creating a new 'metaphysical character' to replace the earlier cyborg figures.

Despite the compelling evidence that underscores the distinction between Foucault's and Derrida's methodologies through their concepts of efficient and inefficient mechanisms, I argue however that much evidence can also be gathered that presents a compelling case for considering certain rapprochements between their two projects. As I will show below, this rapprochement can be constructed through their similar use of a model based on Gödel's undecidability theorems that are themselves rooted in the epistemological debates that recur throughout the history of geometry. In *Michel Foucault: Genealogy as Critique*, for example, theorist Rudy Visker asserts that Foucault's work with *avant garde* writers like Artaud and Roussel in many ways parallels Derrida's in its goal of reading past the fullness of discourse to its conditions of contingency: "[t]he inaudible 'a' in Derrida's *differânce* reflects Foucault's quotation marks in his critiques of "science." Both deploy linguistic signs to suspend syntactical meanings outside stable, metaphysical fullness" (Visker 3). Stephen Watson also acknowledges the similarities between Foucault and Derrida's projects. According to Watson, Foucault's response to Husserlian phenomenology is influenced by several factors, particularly phenomenology's response to the "logicist heritage" of Frege and Russell, and the need for "*l'experience mathêmatique* [to] interface with intuitionism" (Watson 265). Husserlian phenomenology for Foucault, however, "remained divided between two archives" (Watson 265). Watson then aligns Foucault's position on phenomenology with that of Derrida. Quoting Foucault, he begins: "phenomenology is therefore much less the resumption of an old rational goal in the West than the sensitive and precisely formulated acknowledgment of the great hiatus that occurred in the modern *episteme* at the turn of the eighteenth and the nineteenth centuries" (Foucault *OT* 325; in Watson 268). He then refers to Derrida's *Of Grammatology*, published in the same year (1967): "As Derrida similarly put it in the same year, phenomenology was from the beginning constituted on a warp and woof that was not its own" (*Of Grammatology* 67; in Watson 268). In a discussion that includes Foucault's relation to mathematical formalism, Watson's underscoring the similarity of their positions illustrates his own assertion in an early footnote: "Despite these ultimate theoretical differences, the identities between Derrida's and Foucault's works are too often underestimated" (Watson 283 n.2). The tentative tone that Watson uses to compare their work, however, contrasts with the simplistic narrative of unity - estrangement - reunion that commentator Roy Boyne attempts to advance in *Foucault and Derrida: The Other Side of Reason.*

He opens his discussion of Foucault and Derrida's well-known debate over Cartesian rationalism by situating his discussion in a particular narrative: "In many ways this book is a kind of detective story . . . that begins with an academic debate" (Boyne 1). Boyne's "detective story" states that the Foucault/Derrida debate "was not about madness at all, but about the patriarch of Western philosophy, René Descartes (Boyne 1). For Boyne, their debate serves to underscore the fact that both projects were essentially proceeding toward the same goals, "the common ground of power and ethics" (Boyne 2). He continues,

> That such ideas should appear to be their joint destination is especially noteworthy given not only their animosity to one another, but also their shared skepticism and hostility to the main lines of Western philosophy. It is as if both thinkers were separately engaged, from their different points of view, in the same test of reason, at the end of which they found certain elements therein that could not be denied. (Boyne 2)

The strong presence of the narrative form of the "detective story," where Boyne himself plays the role of Holmes, shapes his understanding of the relation between Derrida and Foucault's projects. The simplistic narrative structure continues, though now the metaphor takes on a more martial tone:

> We have, then, a remarkable turn around. Two philosophical opponents leave their field of combat in a state of fundamental disagreement. They develop their work in different directions yet nevertheless meet up again in an unrecognized partnership of theoretical understanding . . . . The circle is now complete. Foucault

> and Derrida both wrote in such a way that what they said could easily be taken as a challenge to, even a rejection of, the apparently self-satisfied ideals of liberalism, enlightenment and universal reason. (Boyne 2 - 3)

Given that neither Foucault nor Derrida represented their own philosophical positions, as these developed and shifted throughout their careers, in the geometric terms of a Euclidean circle, it's difficult to see how this metaphor could sufficiently apply to a *comparison* of their various projects.

In her introduction to Derrida's *Of Grammatology*, translator and theorist Gayatri Spivak also addresses this same debate between Derrida and Foucault over the Cartesian *cogito*. The debate centers around Foucault's reading of Cartesian rationalism as representing, not the development of the thought of one philosopher, in the traditional sense of a history of ideas. Instead, for Foucault the philosophy of Descartes represents a historical moment, apart from human agency, where the concept of madness begins to be separated from that of reason, leading to incarceration, and further, to the human science of psychology. Foucault argues in this early text: "In this sense, the Cartesian formula of doubt is certainly the great exorcism of madness . . . In the uniform lucidity of his closed senses, Descartes has broken with all possible fascination, and if he sees, he is certain of seeing that which he sees" (Foucault *MC* 108). He continues discussing what he sees to be the advent of the uniformity of rationalism, by linking it to the Renaissance system of "internal communications and symbolisms," particularly that of the sun. "This is no longer the fatal time of the planets, it is not yet the lyrical time of the seasons; it is the universal but absolutely divided time of brightness and darkness. A form which thought entirely masters in a mathematical science – Cartesian physics is a kind of *mathesis* of light . . ." (Foucault *MC* 109).

Descartes' skeptical method banishes unreason from the pure sun-light of reason, as demonstrated irrefutably for the Renaissance thinkers by Euclidean geometry.

Derrida responds by critiquing the unity that characterizes madness and reason as separate entities in Foucault. He writes:

> The procedure by which Descartes shows that imagination and dreams cannot themselves create the simple and universal elements which enter into their creations . . . that is, everything which precisely is not of sensory origin, thereby constituting the objects of mathematics and geometry, which themselves are invulnerable to natural doubt. It is thus tempting to believe, along with Foucault, that Descartes wishes to find in the analysis of dreams and sensation a nucleus, an element of proximity and simplicity irreducible to doubt. It is in dreams and in sensory perception that I surmount, or as Foucault says, that I "circumvent" doubt and reconquer a basis of certainty. (Derrida "Cogito and the History of Madness" 46-47)

After proposing several other directions that Foucault's reading could have taken (pp. 48ff), Derrida further criticizes Foucault's treatment of the Cartesian historical moment because of what he considers to be a latent determinism in Foucault's formulation.

> The extent to which doubt and the Cartesian *Cogito* are punctuated by this project of a singular and unprecedented excess – an excess in the direction of the nondetermined, Nothingness or Infinity, an excess which overflows the totality of that which can be thought, the totality of beings and determined meanings, the totality of factual history – is also the extent to which any effort to reduce this [Cartesian] project, to enclose it within a determined historical

> structure, however comprehensive, risks missing the essential, risks dulling the point itself. Such an effort risks doing violence to this project in turn . . . (Derrida *C* 57)

This violence, Derrida continues, is that of a "totalitarian and historicist style," qualifying "totalitarian" for the "structuralist" sense in which he intends the word. As Spivak concurs, the determined characteristic of history in Foucault, (its deep structure), together with the organic characteristic of the organizing *epistemes*, locate Foucault's reading of Cartesian rationalism within "the structuralist science of investigation through oppositions" (Spivak lx). Spivak concedes that "this is a dated Foucault, the Foucault of the sixties" (lx); however she does note, in relation to Derrida, that Foucault's "archaeologies" nonetheless still analyze the *episteme* of a particular epoch according to its metaphors, without examining the implication of the metaphor as technique. Instead, she states, "by describing grammatology as 'a history of the possibility of history that would no longer be archaeology'" (Spivak 43), Derrida seems to declare an advance over Foucault. And by denying the status of a positive science to grammatology, he "'erases' the advance" (Spivak lx – lxi). Foucault responds to Derrida's critique eleven years later, not to announce a reconciliation that will make the circle complete, but to analyze "Derrida's misreading of Descartes" (Spivak lxi). According to Spivak, Foucault's response is "thorough and often convincing . . . but it leaves untouched the configuration of Derrida's suggestion that the Cartesian certitude is grounded on a category that may just as easily be described as either certitude or doubt, neither certitude nor doubt." This formulation echoes that of Gödelian undecidability in the theorems, a sense that is underscored in Spivak's concluding remarks about the Derrida/Foucault exchange:

> In fact when, speaking against Derrida, Foucault shows us that Descartes disqualifies [rather than excludes] madness from giving

> evidence, as an 'excessive and impossible proof' [p. 596], we may suggest that Foucault's reading in this case is not very different from Derrida's. (Spivak lxi).

That somewhat weak similarity, in Spivak's terms, gestures to the "excessive and impossible proofs" demonstrated by Gödel in 1931, which had a formative influence on Derridean deconstruction.

In this later response, Foucault himself does place more weight on the elements involving language, in relation to historic singularities, and thus invites Spivak's comment regarding the similarity between Derrida and Foucault at that moment. But lest we assume that they were about to become close friends, Spivak closes with what she calls a "taste of the hostility" in Foucault's rebuttal:

> Today Derrida is the most decisive representative of a [classical] system in its final glory; the reduction of discursive practice to textual traces; the elision of the events that are produced there in order to retain nothing but marks for a reading; the invention of voices behind texts in order not to have to analyze the modes of implication of the subject in discourse; assigning the spoken and the unspoken in the text to an originary place in order not to reinstate the discursive practices in the field of transformations where they are effectuated . . . [It is] a pedagogy that tells the pupil that there is nothing outside of the text, but that within it, in its interstices, in its white spaces and unspokennesses, the reserve of the origin reigns; it is not at all necessary to search elsewhere, for exactly here, to be sure not in the words, but in words as erasures, in their grill, 'the meaning of being' speaks itself. A pedagogy that conversely gives to the voice of the teacher that unlimited sovereignty which permits them to read the text indefinitely. (p. 602; in Spivak lxii)

In light of Derrida's comments regarding the influence of Gödel's Undecidability theorems on deconstruction (*Husserl's Origin of Geometry: An Introduction;* "The Double"; *Limited Inc.*), Foucault's assertion that deconstruction permits one to read "indefinitely" is inaccurate. However, as theorist David Carroll suggests in "Self-reflexivity and Critical Theory: Foucault," the readings that Foucault himself performs on literary texts function like an abstract machine "not very different from Derrida's." I argue therefore that Foucault's readings resemble Derrida's to a certain extent through the operation of self-reflexivity, the model that was first formally proved by Gödel's theorems.[11] Though this reflexive model does resemble the inefficient interpretive machine that Derrida deploys, the description of Foucault's application of a similarly inefficient machine should be read in the context of the overall direction of Foucault's writings, which were to put in place efficient models, demonstrating how completely they worked. Chapter Five describes this stronger tenor of Foucault's work, particularly in his construction of the (impossibly) efficient disciplinary machine, the Panopticon.

Carroll initiates his discussion about the significance of self-reflexivity in Foucault by asserting that "certain tendencies of contemporary theory [emphasize] the phenomenon of self-reflexivity in art and literature . . . [as exemplified in] the debates between American deconstructionists and their opponents [among others]" (Carroll 53). Later in his essay, Carroll does accept that certain features of Foucault's theory resist inclusion in the anti-epistemology of self-reflexivity. For example, in *The Archaeology of Knowledge*, Carroll notes that

> Foucault attacks all historical and linguistic totalities and replaces them with a modified speech act theory that stresses the performative aspects of discourse and the multiple series with which any 'discursive event' intersects. But even here, in his most developed theoretical statement on discourse, the perspective from

> which discourse can be considered to be constituted entirely as action – that is the perspective of the archaeologist defining the different units of discourse and measuring its effects in different context – is left for the most part uninvestigated. (Carroll 70)

Carroll's criticism of Foucault echoes that of Derrida when he states that Foucault writes as if "he knows what madness means" (Spivak lx; *ED* 66). At issue here is not an indeterminacy at the heart of meaning that Foucault chooses to ignore. Instead, as Carroll states, the issue relates to the position of Foucault's own voice as he attempts to dismantle historical and linguistic totalities:

> The discourse of the archaeologist has the decided privilege of dominating the discursive field, of being extra- or trans-discursive in its ability to describe the way discourse works and distinguish among the different levels and categories of discourse. (Carroll 70 – 71)

Ironically, the position of Foucault's voice reasserts the very totality that he attempts to dismantle.

Foucault acknowledges something along these lines in his introduction to *The Archaeology of Knowledge* when he states that this book gave the "impression that [my] analyses were being conducted in terms of cultural totalities" (Foucault *AK* 16). Thus in a concluding statement Carroll concedes further that "there is a naive, acritical, and even perhaps 'romantic' side to some of Foucault's remarks concerning madness and transgression . . ." (Carroll 78-79). However, within Foucault's work as a "whole" these "decidable" transgressions themselves do not preclude the possibility of an undecidable mechanism from operating elsewhere.

Carroll begins his study of self-referentiality in Foucault by asserting that often Foucault will open a text with a scene that is emblematic of the work that follows. "One characteristic of all of Foucault's major works is undoubtedly the way he stages in miniature their major problematic in the opening chapters, thus delineating a space that he will attempt to saturate in the course of his analyses" (Carroll 54). Thus, since this book attempts to describe the "mechanism of ordering" that triggers the emergence of various *epistemes* throughout history, the book opens appropriately with a "painter standing a little back from his canvas." *The Order of Things* initiates a discourse about the possibility of "representing Representation itself" (Carroll 54). In a move echoing the language-based deconstruction of Derrida, Foucault asserts that it would be possible to give proper names to the subjects in Valesquez's "Las Meninas" (Foucault *OT* 6). These names, he continues, would serve the purpose of "forming useful landmarks and avoiding ambiguous designations; they would tell us . . . what the painter is looking at, and the majority of the characters in the picture along with him" (Foucault *OT* 9). However, opposing Platonism's equation of language/image/soul, Foucault states that ascribing names to the figures in the painting curtails the possibility of reading the painting on a more abstract level, as an emblem of seventeenth century representation.

> But the relation of language to painting is an infinite relation . . . [I]f one wishes to keep the relation of language to vision open, if one wishes to treat their incompatibility as a starting-point for speech instead of as an obstacle to be avoided, so as to stay as close as possible to both, then one must erase those proper names and preserve the infinity of the task. It is perhaps through the medium of this grey, anonymous language, always over-meticulous and repetitive because too broad, that the painting may, little by little, release its illuminations. (Foucault *OT* 9-10)

As Foucault shows in his reading of "Las Meninas," the infinity of the interpretive task derives, not only from the actual content of the painting, but also from the way that content is framed and distributed across the canvas. The organization of Valesquez's painting draws attention to itself as a representation of what it is representing. "Perhaps there exists, in this painting by Valesquez, the representation as it were, of Classical representation, and the definition of the space it opens up to us. And, indeed, representation undertakes to represent itself here in all its elements, with its images, the eyes to which it is offered, the faces it makes visible, the gestures that call it into being" (Foucault *OT* 16). And after noting that the absence of the king in the painting brings about "the necessary disappearance of [a ground that] is its foundation," Foucault concludes: "And representation, freed finally from the relation that was impeding it, can offer itself as representation in its pure form" (Foucault *OT* 16). Similar to Derrida's reading of the mime's undecidable gestures in *Mimique*, Foucault sees the painted figures in "Las Meninas" as freed from a metaphysical structure, freed from the world that swirls past his studio window, and instead set in place as representations of Representation itself.

In the Preface Foucault states that the representational focus of *The Order of Things*

> first arose out of a passage in Borges, out of the laughter that shattered, as I read the passage, all the familiar landmarks of my thought . . . breaking up all the ordered surfaces and all the planes with which we are accustomed to tame the wild profusion of existing things . . . (Foucault *OT* xv)

The passage itself quotes another passage from a 'Chinese encyclopedia' that organizes animals into various sets which "demonstrate the exotic charm of another system of thought" (Foucault *OT* xv). What is surprising for Foucault in this taxonomy is not the fact that animals from fables are in a list alongside animals from nature. Instead, it's their proximity in this list, their sequentiality: "What transgresses the boundaries of all imagination, of all possible thought, is simply that alphabetical series (a, b, c, d) which links each of those categories to all the others" (Foucault *OT* xvi). These animals, he remarks further, could never meet in any space other than that of language. And even in the poetic language of Borges, no attempt is made to sketch out a table that would systematize their relationship to each other:

> The central category of animals 'included in the present classification', with its explicit reference to paradoxes we are familiar with, is indication enough that we shall never succeed in defining a stable relation of contained to container between each of these categories and that which includes them all: if all the animals divided up here can be placed without exception in one of the divisions of this list, then aren't all the other divisions to be found in that one division too? And then again, in what space would that single, inclusive division have its existence. Absurdity destroys the *and* of the enumeration by making impossible the *in* where the things enumerated would be divided up. (Foucault *OT* xv)

The fact that the list of animals contains, together with the real and fabulous, an all-inclusive category, "included in the present classification" (Foucault *OT* xv), introduces a paradox of self-referentiality that renders the logical system untenable, as Gödel's theorems demonstrate.

Although the content of the problem was different, nineteenth century geometers faced an identically untenable principle in the self-referentiality that was implicit in Euclid's fifth postulate regarding parallel lines that proceed to infinity. As Carroll notes, "The problem of the set of all sets is a basic one for logic, for how can a category remain one category among others, and, at the same time, include all other categories, including itself within it? How can it be simultaneously one among many and all-encompassing?" (Carroll 56). As I have shown in the discussion above, Gödel demonstrated that in fact logical structures will always generate "antinomies" of self-referentiality that are ultimately un-resolvable.

For Carroll, paradox surfaces at that moment when one *episteme* terminates and another emerges. Noting that in *The Order of Things*, "Foucault insists there is only one *episteme* for a given epoch" (*OT* 168), Carroll continues, "Throughout *The Order of Things* Foucault's analyses of the various epistemological spaces terminate with them being put into question at the very moment when their cycle is complete, when the possibilities of the *episteme* have been most fully realized through a process of self-reflection" (Carroll 66). As time goes on, Foucault makes increasingly modest claims for the *episteme*, as he shows in the Foreword to the English edition of *The Order of Things*. In the Foreword he says that this work does not attempt to discuss the historic conditions that shape each *episteme* in universal terms. Instead he emphasizes that *The Order of Things* is "a strictly regional study" (Foucault *OT* xi). According to commentator Thomas Flynn, likewise, Foucault demonstrates the more modest application of his *episteme* by "locating the epistemological break of the life sciences, economics, and languages at the beginning of the nineteenth century and that for history and politics at the middle" (Flynn 66). To make this application of the *episteme*, Foucault distinguishes his conception of the *epistemic* from the transcendental forms described in Kantian idealism. Instead of referencing the timeless and universal assumptions behind Kant's transcendental forms, he states that "the term (*episteme*) simply denotes 'all those relationships which existed between various sectors of science during a given epoch'" (Flynn

33). Thus, Foucault's own description of his project corroborates Flynn's sense of the *epistemic* as un-teleological and multiple. But Foucault's description of the *epistemes* that characterize an epoch, as part of a project that he calls "archaeology," gives a clearer sense of his intention to describe *epistemic* similarities across a broad (or "deep," in the archaeological metaphor) range of cultural and scientific formations:

> I am not concerned, therefore, to describe the progress of knowledge towards an objectivity in which today's science can finally be recognized; what I am attempting to bring to light is the epistemological field, the *episteme* in which knowledge, envisaged apart from all criteria having reference to its rational value or to its objective forms, grounds its positivity and thereby manifests a history which is not that of its growing perfection, but rather that of its conditions of possibility; in this account, what should appear are those configurations within the space of knowledge which have given rise to the diverse forms of empirical science. Such an enterprise is not so much a history, in the traditional meaning of that word, as an 'archaeology'. (Foucault *OT* xxii)

Foucault's interest in the *loose* structures, "the conditions of possibility" that shape an *episteme*, to some extent counters writer Edward Said's early criticism of Foucauldian historicism, of creating a sense of "involuntarism" for subjectivity (Said 156). However, what seems to be unavoidable in Foucault's account here are the self-organizing characteristics of "a history" whose "configurations" do not appear as a result of human intervention. The "conditions of possibility" that Foucauldian historicism would draw out "give rise to the diverse forms of empirical science" (Foucault *OT* xxii) Evident in Foucault's text is the passive construction of the verbs in this passage, underscoring the fact that the events of history take place as a result of historic processes (however multiple or dispersed) and not as a result of human agency.

Epistemic formations cross various thresholds before becoming formalized as 'science', much like self-organizing phenomena in the natural realm. Foucault intends the inevitability that directs his conception of history to counteract the figure of man from humanist models of history, as leading the march of progress. Opposition to this processural historical model leads to his well-known, bleakly deterministic concluding statement in *The Order of Things*:

> As the archaeology of our thought easily shows, man is an invention of recent date. And one perhaps nearing its end.
>
> If those arrangements were to disappear as they appeared, if some event of which we can at the moment do no more than sense the possibility – without knowing either what its form will be or what it promises – were to cause them to crumble, as the ground of Classical thought did, at the end of the eighteenth century, then one can certainly wager that man would be erased, like a face drawn in sand at the edge of the sea. (Foucault *OT* 387)

My approach, therefore, to counter the determinist paradigms in Foucauldian historicism, while preventing the humanist conceptions to reenter, would bring to the surface a clearer sense of the way undecidability, first formally proved by Gödel, operates in the Foucauldian *episteme*, much as undecidability operates in Derridean *écriture*. Although Hayles argues against Foucauldian concepts of historical formations because they 'universalize' the human body, my own position in this dissertation is that the economy of inefficiency that can be made to operate in Foucault's *episteme* offers richer possibilities than the unacknowledged restricted economy of the efficient exchange of energy and capital that ceaselessly operates behind the scenes in Hayles's formulation.

Although the model of undecidability itself resists closure in a dialectical synthesis, it will be useful to delineate the sense in which I employ it here. As Derrida states in "The Double Session," undecidability does not describe a lexical richness that preserves a fundamental, metaphysical status for the word. Instead, undecidability recognizes in the announcement of a term such as *episteme* the conditions for an oppositional formation. Unlike Hegel's conception of history as a series of dialectical movements that are subject to synthesis, the duality of a historic formation that is undecidable finally remains unresolved. The late twentieth-century *episteme* to which I apply this model of undecidability is that of the posthuman, as it is defended and celebrated most notably by Kathryn Hayles.

Chapter Three

Gödelian Undecidability and the Word: Deconstructing a Posthuman *Episteme*

In *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* philosopher of science, Kathryn Hayles argues for what could be called a posthuman *episteme*. Although it might seem possible to construct a genealogy of the posthuman that would trace its roots back to earlier universal theories involving machines, especially those that I have discussed here by Plato, Aristotle, Descartes and Leibniz, in fact the strongest connection that could be made would instead derive from their shared aspiration of constructing systems that operate efficiently, without expelling waste. Whereas each of these early applications of Euclidean geometry did describe the universe in mechanistic terms, Hayles's posthumanism importantly posits a universe that is fundamentally organic but is joined with machines in order to enhance the natural environment. The unacknowledged economies that are required to maintain this link would require vast resources of energy and capital in her formulation, particularly since posthumanism is predicated on an untenable system that operates with complete efficiency.

She initiates her discussion with a provisional definition of "posthuman": "Although the 'posthuman' differs in its articulations, a common theme is the union of the human with the intelligent machine" (Hayles 2). Hayles expands on the meaning of "posthuman" by stating that the term draws together at least four viewpoints in the relation between human and machine. The first of these emphasizes the importance of information patterns and flows across biological and technological thresholds. This information flows across biological and technological thresholds at the expense of the embodiment of the human subject who has merged with the machine. For Hayles, the posthuman thus assumes "that embodiment in a biological substrate is an accident of history rather than an inevitability of life" (Hayles 2). For the posthuman *episteme* therefore, this embodiment in a "biological substrate" can just as easily be modified, or reversed. Secondly, the posthuman perspective assumes that human consciousness has a diminished significance in relation to the 'consciousness' of machines. Although "human identity" has traditionally been associated with the human ability to think in Western philosophy, "long before Descartes thought he was a mind thinking," in fact, from the posthuman point of view, the human ability to think is also only a minor evolutionary blip. This ability, posthumanists aver, will become secondary to the thinking of machines, which may in fact be already superior to humans in this regard. Thirdly, posthumanists consider the body itself as a prosthesis. In their view the body is separated from the consciousness of the individual. That consciousness gets the body to do things. But for them, nothing privileges a biological prosthesis over a technological one, since often technological prostheses are more durable and have greater functionality anyway. The various parts of the body thus can be replaced and substituted by other, technological, prostheses. Finally, the posthuman approach assumes that human biology can in fact completely integrate with technology, "that it can seamlessly [be] articulated with intelligent machines." Hayles continues, "In the posthuman, there are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanism and biological organism, robot teleology and human goals" (Hayles 3). These fuzzy borders between carbon and silicon systems, they would argue, permit their total merger, much like two clouds from two approaching weather patterns.

According to Hayles, the possibility of this merger of humans and machines requires a re-thinking of definitions of human subjectivity, definitions that contrast with previous assumptions that were advanced by liberal humanism. Hayles:

> Consider the six-million-dollar man, a paradigmatic citizen of the posthuman regime. As his name implies, his parts of the self are indeed owned, but they are owned precisely because they were purchased, not because ownership is a natural condition preexisting market relations. Similarly, the presumption that there is an agency, desire, or will belonging to the self and clearly distinguished from the "wills of others" is undercut in the posthuman, for the posthuman's collective heterogeneous quality implies a distributed cognition located in disparate parts that may be in only tenuous communication with one another. (Hayles 4)

Hayles asserts that by describing the posthuman in a favourable light she is "not trying to recuperate the liberal subject." Instead, she writes, "I think that serious consideration needs to be given to how certain characteristics associated with the liberal subject, especially agency and choice, can be articulated within a posthuman context" (Hayles 5). Her optimism in the re-constitutive power of technology echoes Donna Haraway's optimistic statement in "Simians, Cyborgs and Women," that the connection of the human subject with emerging technologies permits the expression of new identities, apart from those distributed across the grid of liberal humanism. Hayles concludes her statement of purpose in the same direction: ". . . my dream is a version of the posthuman that embraces the possibilities of information technologies without being seduced by fantasies of unlimited power and disembodied immortality, that recognizes and celebrates finitude as a condition of human being, and that understands human life is embedded in a material world of great complexity, one on which we depend for our continued survival" (Hayles 5). With these purposes as an organizing frame, Hayles nuances her description of the posthuman figure, by referring to the terms in the book title, *How We Became Posthuman*, yet these explanations do not deepen our understanding of how the posthuman could operate on a fundamental level.

If one ignores the ironies that she intended in the title, Hayles states, one could nonetheless recognize that the title announces a separation from liberal humanist structures as she indeed intends. This distinction is registered in the simple past tense of "became," as well as in the sequentiality implied by the term "post" in *post*human. However, these terms, seeming to announce a sharp historic break, she states, in fact preclude such a break from taking place. "Rather," she writes, "'human' and 'posthuman' coexist in shifting configurations that vary with historically specific contexts" (Hayles 6). Furthermore, for Hayles, this lack of a clean break, historically, between the human and the posthuman periods is also reflected in the "We" of her title. In the context of posthumanism, the subject can no longer think of himself in metaphysical terms, as being organically whole and teleologically driven. Instead it might be more 'natural' in this context to think of the various parts of the body that could be replaced like technologies, to improve their functions. Furthermore, Hayles intends this "we" to stand in opposition to the "we" that is purveyed by magazines like *Mondo 2000*. These magazines of techno-hype construct their readership as "the world," when in fact only a "small fraction of the world's population" has access to the technologies described in their pages.

In these introductory statements, Hayles carefully locates the posthuman subject in a way that preserves the hallmarks of postmodern subjectivity. As is consistent with the conventions of postmodern thought as expressed by Foucault and Derrida, the postmodern subject is comprised of an identity that is multiple, fragmentary and without teleology. For Hayles, the posthuman merger of biology and technology achieves the de-centred condition favoured by postmodernism, thus avoiding the spectre of a resurrected humanism. Although, as her three part history of cybernetics shows, much of that history has attempted to advance the seamless merger of mind and machine, Hayles argues that only a fully embodied merger of bio-tech can prevent a return to humanist assumptions that preserve the fundamental power of the independent mind against the non-rational, intuitive knowledges that are associated with the body, and that resist complete synthesis in one single doctrine.

The sophisticated discussion regarding the connectedness of biology with technology shows why Hayles's work is held in high regard. Her statement near the end regarding the levels of society that need to work together in order to more completely understand the relation of bodies and machines demonstrates an insight that proceeds from this sophisticated beginning:

> . . . finally the answers to questions about the posthuman will not be found in books, or at least not only in books. Rather, the answers will be the mutual creation of a planet full of humans struggling to bring into existence a future in which we can continue to survive, continue to find meaning for ourselves and our children, and continue to ponder our kinship with and differences from the intelligent machines with which our destinies are increasingly entwined. (Hayles 282)

In contrast with the rational model advocated by Descartes and Leibniz, where understanding is gained by solitary processes of reason, Hayles' vision is communal, inviting communities and families to work (and read) together to resolve issues involving their relation with technology.

Despite the initial strengths of Hayles' argument, the conclusions she draws in the final chapter are unsatisfactorily weak. This weakness, I argue, is not due to faulty reasoning on Hayles' part, but derives instead from the *episteme* of the posthuman that she announces, "[which] evokes the exhilarating prospect of getting out of some of the old boxes and opening up new ways of thinking about what being human means" (Hayles 285). Her assertion regarding the possibility of 'opening up new ways of thinking', I contend, paradoxically makes an implicit announcement that suspends the overt declaration of a new posthuman *episteme* in much the same way that Derrida's application of Gödel's Undecidability theorems in deconstruction finds paradoxical contradictions operating within apparently unified terms. Because of this implicit contradiction, the posthuman *episteme* does not become a historic singularity, providing the epistemological foundation about which Leibniz, with his logical calculators, had dreamed. In advancing her optimistic thesis about the posthuman future, Hayles suggests that this future means "positing a shift from presence/absence to pattern/randomness" (Hayles 285). However, her brief description of the deconstruction that she believes the posthuman will displace only tells what it needs to in order to be a more satisfying target for her critique. She simplistically writes:

> In Jacques Derrida's performance of presence/absence, presence is allied with Logos, God, teleology – in general, with an originary plenitude that can act to ground signification and give order and meaning to the trajectory of history . . . It is a now familiar story how deconstruction exposed the inability of systems to posit their own origins, thus ungrounding signification and rendering meaning indeterminate . . . . Important as these moves have been in late-twentieth-century thought, they still took place within the compass of the presence/absence dialectic. (Hayles 285)

In fact, as my reading of "The Double Session," *Introduction to the Origin of Geometry*, and *Limited Inc.* has shown, Derrida's very concern in deconstruction was not to construct a completely nihilist, anti-epistemological model. Through the influence that Gödelian geometry had in shaping deconstruction from his first book through to a later one, he attempts to give deconstruction a shape, where meaning is not indeterminate, but undecidable, pivoting between two oppositional yet irreducible meanings. Although the terms presence/absence do have a binary quality to them, it's not accurate in a philosophical context to speak of them as a dialectic, since in a dialectical model, the ultimate goal is synthesis, a teleology that deconstruction resists.

The "dialectic" that Hayles proposes in its place has the advantage, she contends, of "*not* front-load[ing] meaning into the system" (Hayles 285). Instead, she argues, the pattern/randomness dialectic brings meaning to the system later in the process, in unpredictable and aleatory ways:

> As we have seen for multi-agent simulations, complexity evolves from highly recursive processes being applied to simple rules. Rather than proceeding along a trajectory toward a known end, such systems evolve toward an open future marked by contingency and unpredictability. Meaning is not guaranteed by a coherent origin; rather, it is made possible (but not inevitable) by the blind force of evolution finding workable solutions within given parameters. (Hayles 285)

Although Hayles apparently posits a model that is an "evolutionary" advance over Derridean deconstruction, the terms that she uses to show posthumanism's opposition to deconstruction are actually borrowed *from* deconstruction. In other words, in suggesting that the pattern/randomness model of the posthuman "does not proceed along a trajectory toward a known end," and "evolves toward a future marked by contingency and unpredictability," she is drawing on the aleatory and non-teleological lexicon of deconstruction itself. The only term that Derrida probably would not have used in Hayles's formulation is the linear verb "to evolve."

Furthermore, although Hayles shows that she is familiar with the work of physicist Alan Turing, she does not refer to one of his well-known theories that would have complicated (interestingly) the posthuman model that she was trying to advance. Briefly, Turing's theory is called the *Halting Problem* and is based on the same principles as Gödel's Undecidability theorems. Craig Kaplan summarizes Turing's *Halting Problem* as follows:

> First of all, I'll be precise about some of the terms I'm going to use here.
>
> A "problem" is a yes/no question that we ask of a particular input. Here are some sample problems:
>
> * Given x, y and z, does $x + y = z$?
> * Is the number x prime?
> * Is a given sentence grammatical?
>
> An "algorithm" is a solution to a problem if it correctly provides the appropriate yes/no answer to the problem, and is guaranteed to always run in a finite amount of time.
>
> A "problem" is decidable if it has a solution. If there is no algorithm that solves the problem in a finite amount of time, the problem is undecidable.

> Turing's Argument
>
> Are all problems decidable? Given enough thought, can we always come up with a well-defined procedure that takes some input and answers a given question about it? At the start of the 20th-century, the belief was that this was true. Mathematicians (following Leibniz) believed that we would eventually discover tools that we could use to answer any question we wanted (provided we could express it in the language of logic).
>
> In 1931, Kurt Gödel shocked them all by proving that this was impossible. Using numbers to represent logical steps, he showed that as soon as we devise a system that's sufficiently powerful and well-behaved to encompass mathematical reasoning, that system will necessarily contain a statement that we could never prove is true, even though it *is* true.
>
> A few years later, Alan Turing proved an analogous theorem in Computer science. He showed that there must exist undecidable problems, questions for which there is no definable solution. His proof relied on some of the same techniques used by Gödel. (Kaplan)

The merging of human with machine, as proposed by Hayles, however, only continues to "evolve," never stumbling on a loop that causes it to halt and spin indefinitely. Despite Turing's early discovery of paradox in computing, Hayles' optimism in the power of technology expands to include "everything," not only the "patterns" on the one side of this dialectic, but also the "randomness" on the other. After listing several scientists for whom randomness plays an important role in their research, she notes, "Although these models differ in their specifics, they agree in seeing randomness not simply as the lack of pattern but as the creative ground from which pattern can emerge" (Hayles 286). Despite her credentials as a philosopher of science, Hayles does not address the formal proofs that demonstrated the limitations of formal, machinic systems. Plotnitsky's brief summary gets straight to the point: "Mathematical machines, as Alan Turing and Kurt Gödel demonstrated, are never sufficient even for mathematics" (Plotnitsky *R* 315).

Although Hayles makes earlier statements regarding the possibility of creating new human identities that would be empowering, without resorting to humanist codes to do so, her enthusiasm for the evolution of technology keeps mounting to the point where it serves ironically as a humanist metaphysics that can indeed "explain" everything. She concludes in agreement with Richard Lanham, that the only resource that is needed to bring about the "expanding power and sophistication of intelligent machines" is the "scarce commodity [of] human attention" (Hayles 287). Her early reference to the "six million dollar man" seemed to indicate her awareness of economic contingencies in technological "progress." However, Hayles' posthuman model functions as a *perpetuum mobile*, never drawing in the capital that would be needed on a consistent basis to ensure that the sutures stitching the body to technology don't pop open. Hayles' enthusiasm for the advance of technology, severed from questions relating to economics, reminds one of political scientist Arthur Kroker's similar critique of Marshall McLuhan's technological optimism:

> McLuhan had no systematic, or even eclectic, theory of the relationship between economy and technology; and certainly no critical appreciation of the appropriation and thus privatisation of technology by the lead institutions, multi-national corporations and

> the state, in advanced industrial societies. [Like Hayles, McLuhan believes] that technology is part of our bodies; and to the extent that corporations acquire private control over the electronic media then we have, in effect, leased out our eyes, ears, fingers, legs, and the brain itself, to an exterior power. (Kroker 79)

Furthermore, Hayles describes technology as if it were one quickly evolving entity, a shiny machine that wants to embrace the posthuman subject. If one may venture to adapt Derrida's critique of Foucault: she speaks as if she knew what 'technology' was. Would it not also be fair to ask whether these "intelligent" machines include the little electric machines that have permeated the domestic sphere? Do they include the increasingly "intelligent" automobile, with its vocal warnings about seatbelts and speed, its Global Positioning Satellite system, its nightvision windshields? If so, what is the threshold of this machinic intelligence? Would the red seatbelt light in the 1986 Honda I sometimes drive qualify on a primitive level? Presumably the advantages of the posthuman that Hayles describes refer to networks of computers, but even here a Turing machine triggers an infinite loop in this *episteme*. In order to benefit from the computing potential of the posthuman, one needs to be of a certain economic class. But in order to rise to that class, one needs to first buy a computer. Hayles' reading concludes therefore with a high level, that is, abstract, language without having addressed the antinomies in posthumanism that prevent the project from advancing smoothly:

> The best possible time to contest what the posthuman means is now, before the trains of thought it embodies have been laid down so firmly that it would take dynamite to change them. Although some current versions of the posthuman point toward the anti-human and the apocalyptic, we can craft others that will be

> conducive to the long-range survival of humans and of the other life-forms with whom we share the planet and ourselves. (Hayles 291)

Although her opening statements demonstrate Hayles' awareness of issues relating to technological access, her conclusion ignores these issues. It could be useful then to 'deconstruct' her language, unpacking the 'we' who can "contest what the posthuman means"; and opening up the "craft" of other versions of the posthuman "that will be conducive to the long-range survival of humans . . ." In these vague terms, Hayles does not state what it could mean for someone (that is, most people on the planet) who neither owns a computer, nor has access to the internet, to begin this "crafting" of versions of the posthuman. In fact simple, sustainable technologies such as manual water pumps are developed and distributed in some poorer parts of the world. But it would seem that this kind of 'craft' by these kinds of 'cyborgs' is not what Hayles has in mind. The unspoken assumption in Hayles's formulation is that intense amounts of capital will be available to facilitate the kinds of wiring of human and machine that produce glamorous results and newspaper headlines.

A further unspoken assumption in her formulation, therefore, is that this crafting of new relationships with technology will be performed alongside of, and in the interests of the huge global corporations that will have the kind of capital available to sink into projects like hers. Paradoxically, the economically poorer people who do not have access to technology, and may not necessarily see the point, are the ones being excluded by this same global economy that in fact gives someone like Hayles access to these structures. Ultimately, Hayles' rhetoric echoes that of Kevin Kelly, executive editor of *Wired* magazine. In the days before high tech stocks started to slide, and internet economies started to vaporize, Kelly writes (breathlessly) of a brave future of "intelligent machines," similar to that proposed by Hayles:

> The wholesale transfer of bio-logic into machines should fill us with awe. When the union of the born and the made is complete, our fabrications will learn, adapt, heal themselves, and evolve. This is a power we have hardly dreamt of yet. The aggregate capacity of millions of biological machines may someday match our own skill of innovation . . .
>
> The world of the made will soon be like the world of the born: autonomous, adaptable, and creative but, consequently, out of our control. I think that's a great bargain. (Kelly 4)

Again, an economic metaphor is invoked in Kelly's perception of the "bargain" of losing control of a machine that has been made. But as with Hayles, the site of exchange that transfers money, or social value, or shifts in power 'goes' (because it is dynamic) unexamined.

In postulating that these rationales for a posthuman *episteme* can be deconstructed to find the point at which they will "halt," or "loop" I am not advocating a return to duller, more supposedly 'authentic' modes. In this sense Derrida's machines are irreducible, as he states, since a return to nature also involves constructions of many kinds, including narratives of return and images of nature as pristine and true. Instead I would suggest that the fact that machines are not sufficient for everything puts 'them' in a much more complex and interesting relation with the human realm. Thus, if the posthuman condition also includes the conditions that prevent the posthuman from advancing, one could not assume that some purely biological, human condition were in fact available. Instead, to draw on Derrida's conception of Gödelian undecidability, the *episteme* of the posthuman oscillates between its technological and biological conditions.

Chapter Four

Gödelian Undecidability: Reading the Posthuman *Episteme* in Ridley Scott's *Blade Runner*

(1)

The geometric term "undecidability" operating in a posthuman *episteme* appears in representations of technology in the cyber-punk genre.[12] I will read Ridley Scott's well-known "cult-film," *Blade Runner: The Director's Cut* (1993), to demonstrate that cyber-punk texts usually represent technology as threatful, eventually nihilistic; however, in *Blade Runner* the technologically infused environment is not completely deterministic.[13] I will argue that the undecidability of the posthuman *episteme* that prevents one term (technology) from banishing the other (humanity) responds to qualify both the optimism of a theorist such as Hayles and the pessimism of cyber-punk. Paradoxically, technology, which presumably enables society, contributes to the sense of dread in cyber-punk narratives because of the pressure it places on human subjectivity.[14] This pressure seems to increase as technology advances: as the machines improve they also move closer. As technology improves in cyber-punk fictions, the quality of human life tends to decline, thus raising the question of what it means for technology to "improve."[15]

In this chapter I contend that the continuum that illustrates one of *Blade Runner*'s motifs, the graduated (but unresolved) distinction between the human and the machine, is reinforced through the language of geometry, since both draw on the geometric model to explain their fundamental operations. However, before doing so I draw attention to the contrast between the inefficient machinery of deconstruction, and the 'efficient' mechanisms of posthumanism. For example, many commentators see the beginnings of abstract reasoning, attributed to Thales's early geometry, as the early development of the rational facility that ultimately sets humans apart from animals. However, the attempt to formalize sound reasoning into an axiomatic structure also helps develop the formal languages that machines use to communicate with each other and with people. Thus the description of a genealogy of geometry's relation to epistemology can also be read as a genealogy of geometry's relation to technology. The matrix of geometry-epistemology-technology is not only linked through questions of language. This matrix links together through the metaphor, and eventually the object, of mechanism; however, as my study has shown above, Derrida's application of 'mechanism' draws on its inefficiency, whereas Hayles's application draws on its efficiency. The attempt at mechanizing thought, thereby attempting to make it more efficient through the axioms of geometric reasoning, was practiced for centuries by geometers, who tried to identify only the logical steps that were necessary for reason to operate, banishing irrational, non-mechanical qualities such as intuitions, hunches and dreams.

The *Oxford English Dictionary's* statement that "[t]he mod. Latin word [for "mechanism"] was chiefly used to denote the mechanical structure and action of nature according to the Cartesian philosophy" shows the compelling quality of this metaphor as Hayles employs it. However, as I argue in my reading of *Blade Runner*, the mechanistic model can be more productive ironically through its inefficiency, in the way that Derrida models deconstruction on the undecidability of Gödel's theorems in geometry. David Channell's discussion in "The Mechanical World View: The Clockwork Universe" shows the significance of applications of this model as 'efficient' to 'mechanist' philosophers such as Descartes:

> Although many of Descartes' explanations of physical phenomena, especially his reliance on the vortex, were rejected by later scientists, his philosophy became the cornerstone of the mechanical world

> view. He replaced the world of the senses with an ideal world based on geometric quantities and provided a philosophical foundation for Galileo's distinction between primary and secondary qualities. Descartes' dualism between mind and body separated the primary qualities of extension and motion from the secondary qualities of sensation . . . More and more the world was seen as being removed from our actual experiences by functioning almost like a giant machine. (Channell 18)

Although Descartes is credited with laying the "cornerstone" for a mechanical worldview, based fundamentally on his understanding of geometry, the idea of linking "mechanism" with reason and number to explain the efficient operation of the universe did not originate with him. Instead, Channell finds three contributing ideas "(atomistic, mathematical and mechanistic explanations of natural phenomena) in ancient Greek civilization" (Channell 11). Whereas the linking of technology with biology in films like *Blade Runner* presumably enables humans' access to greater amounts of power that make them more dynamic and mobile, classical applications of mechanistic models served a more stabilizing purpose.

According to Channell, the motivation for linking these ideas for ancient Greek civilization was to establish a stable pattern of certainty behind the apparent change that characterized much of human experience. After discussing various number/mechanical theories that were advanced to explain the functions of the universe (including those of the Pythagoreans, of Leucippus and of Plato), Channell describes the influence that Greek astronomers played in linking together issues of epistemology, number and mechanism:

> Greek astronomers paved the way for mechanistic models of the universe. Since they assumed that celestial bodies, being perfect, moved in perfect circular paths, it became the goal of Greek

> astronomy to reduce the observed irregular motion of the planets around the earth to some form of uniform circular motion. One of the most successful solutions to the problem was put forward by Plato's student Eudoxus, who devised a system of concentric spheres centered on the earth . . . As historian Otto Mayr has argued, these geometric models served as the basis for actual mechanical models such as the famous planetarium of Archimedes and also as the forerunners of the medieval astrolabe in which a flat disk, representing the stars, and movable grids for the planets, could be pursued to calculate the position of the heavens.
>
> The success of these geometric and mechanical models led many people to the conclusion that the universe was, in fact, a mechanical system. For example, Aristotle argued that the universe was composed of fifty-five concentric crystalline spheres. A number of the spheres added by Aristotle functioned as mechanical linkages and "idle wheels" so that the motion of the outer sphere of the stars could drive all of the planets. (Channell 12 – 13)

Channell's discussion then considers the ways in which these conceptions of the universe as functioning like a mathematical machine began to influence conceptions of physiology and of psychology as well, with the heart operating as a "pump," and the mind as an "engine," for example.

Thus, the facility that seems most human, of reason, is also linked metaphorically to the functions of entities that seem least human, that is, machines. Perhaps this inner tension, describing rational mental processes in mechanistic terms, helps explain why the focus of much discussion in cybernetics, regarding the relation between humans and technology, centres on Gödel's Undecidability Theorems of the early twentieth-century. In formally (that is, mechanistically) proving the limitations of formal structures (which include machines with their formal languages), Gödel not only raises doubts about the possibility of establishing foundations for epistemology. He also raises questions about the possibility of establishing an ontology of both humans and technology. To the degree that both of these issues in Gödel's theorems can function as anti-metaphysics, both have significance for Derridean deconstruction. These issues regarding the anti-epistemological implications of Gödel's theorems, as described by Derrida, are not addressed in the discussions of fractal geometry, chaos theory and posthumanism, undertaken by a variety of commentators, but particularly by Hayles, as I have argued above.

Although Hayles conceives the posthuman as celebrating the merger of humans and machines, in the example of *Blade Runner*, the humans and machines of this *episteme* do not merge. They trade places instead. While the machines dream, fantasize and show feelings, the humans swarm on the street, all motion with no destination. For the humans there is literally no place like home. The extension of Descartes and Leibniz's rationalism into the mathematical logic of the machine does not lead to a nightmare of technological determinism in *Blade Runner's* narrative. Instead the *cogito* leads to its opposite, that of the non-rational forms of knowledge that Descartes believed could not be trusted. Throughout *Blade Runner* the antinomies of biology and technology remain unresolved. "*Tertium datur*. Without synthesis" (Derrida *D* 219).

As with other key terms such as "technology" and "discourse," Foucault does not define *episteme*, choosing instead to show how a term like this performs. Perhaps one reason for his refusal to define these terms derives from his argument that historical contingency affected the way key terms such as these surfaced and circulated throughout various epochs. To attempt definitions would undermine the assumptions of his historicism. Although he refuses to define *episteme*, we can watch how it operates in *Blade Runner* by reading George Canguilhem's discussion of the *episteme*. In his essay "The Death of Man, or Exhaustion of the Cogito?," he explains:

> the importance of the *episteme*, this basis of a possible science is what Foucault calls an *episteme* . . . . [s]eventeenth-century science marks the disappearance of an old system of magic and superstition, and the entry of nature into the scientific order. It is important to grasp the modifications that affected knowledge itself, at that archaic level which makes possible both knowledge itself and the mode of being of what is to be known . . . . Other domains of grammar, taxonomy, economy appear at the same time, under this science of order. In the seventeenth century, to know nature is no longer to decipher it but to represent it. (Canguilhem 76)

The shift from one mode of representation ("an old system of magic and superstition") to another ("the entry of nature into the scientific order") signals the operation of an *episteme*, where one widespread historical system gives way to another. This more recent development in the late twentieth-century, where discourses of science and nature are taken from the purview of specialists and located among the relatively flashy and transient artifacts of popular culture, marks another shift. Alongside scholarly articles that provide reasoned discussions of the implications of bringing nature and technology into closer proximity, popular entertainment also takes up these issues in the various forms of media:

> The basic *episteme*, for a given culture, is in a way its universal system of reference to a given period . . . . The concept of the *episteme* is that of a humus on which only certain forms of discursive organization can grow, and for which the confrontation with other forms cannot arise from a value judgment. No

> philosophy today is less normative than Foucault's, none is more alien to the distinction between the normal and the pathological. What characterizes modern thought, according to him, is that it is neither willing nor able to propose a morality. Here again the humanists, invited to forego their sermonizing, respond with indignation. (Canguilhem 83-84)

Although the Foucauldian *episteme* offers the possibility of conducting readings, such as the one here on posthuman mergers in *Blade Runner*, one of the weaknesses of Foucault's formulation, as many commentators have noted, is the lack of historical reference to the *episteme* itself. Canguilhem confronts this difficulty when he asks: "Is the *episteme*, the reason for conceiving of a program for overturning history, something more than an intellectual construct? What kind of object is it for what kind of discourse? It is a paradox that the *episteme* is not an object for epistemology" (Canguilhem 81). Although he responds in Foucault's defense, his proposal to these questions merely restates the problem of the *episteme's* own historicity:

> The verification of the discourse on the *episteme* depends upon the variety of domains in which the invariant is discovered. In order to perceive the *episteme*, it was necessary to exit from a given science and from the history of a given science; it was necessary to try to become a specialist not of generality, but of interregionality. (Canguilhem 81)

A detailed examination of Foucault's own historical position extends beyond the scope of this discussion. However, this weakness in Foucault's conception of the *episteme* does not prevent him from mobilizing it. This chapter will chart the interregionality of technology and biology in *Blade Runner*, arguing that despite some shared territorial borders, their regions never merge as an *episteme*.

An initial screening of *Blade Runner* may appear to challenge my argument, that technology and biology ultimately do not merge. Technology apparently encroaches on space occupied by humans throughout the narrative initially. The vector of technology's movement appears not necessarily linear (in Derrida's reading of the metaphysics of linearity) and inclined at a constant angle, but to repeat the geometric model of a collapsing circle, or of a thickening web, which inhibits the movement of the human. As postmodern theorist Fredric Jameson writes: "[Post-modern space] involves the suppression of distance . . . and the relentless saturation of any remaining empty places . . ." (Jameson 351). Geometric metaphors play a predominant role in cyber-punk, particularly as connections between the machinic and human realms. The geometric metaphor that I would argue underpins *Blade Runner* demonstrates how technology, both as objects and as abstractions, aggressively saturates the urban space, inhibiting free movement across its endlessly repeated patterns. Instead of the simple, even comforting, grid of street blocks to organize and distribute urban dwellers across city space, offering deterrence, opacity and hyper-regulation rather than presumed comforts of order, the geometric patterns in *Blade Runner* repeat each other across all scales.

Urban sprawl expands vertically. To draw on Foucault's terms, *Blade Runner's* disciplinary technology could be not only carceral (keeping the citizens within city walls), it has also become internalized, permeating the very cellular structure of life.[16] Although the 'scientific' theory of fractal geometry informing these repeating patterns has often, but only superficially, appeared in popular culture, in *Blade Runner's* dense environment these fractal patterns play an important, sustained role, emphasizing how humanity has internalized disciplinary mechanisms as the machines themselves continue to advance. One of my purposes here is to argue that this model of fractal geometry, signifying the unhindered progress of cyborg[17] entities, becomes ultimately suspended in this film precisely through "mechanisms" associated with Gödel's undecidability theorems.

SF theorist Scott Bukatman usefully identifies representations of technology as evolving, or self-organizing, in *Terminal Identity: The Virtual Subject in Post-Modern Science Fiction*. He contends that the emergent fractal patterns in the design of the urban spaces of *Blade Runner* present "order and disorder, similarity across scale, a world of infinite detail and complexity . . . the hallmarks of the dynamical systems which constitute our world" (Bukatman 134). I agree with Bukatman's claims, but would also point out that these dynamical systems create patterns on the monolithic scale of the film's Los Angeles, frequently represented from above, in the dense architecture of the mega-corporate office towers. Such patterning frequently reappears in the complex genetic structure of the synthetic snakeskin revealed under the lens of a microscope at street level. At the outset, this film informs viewers how to read it. The camera's opening descent "traces a detailed path across scalar levels, with each pass revealing further complex forms" (Bukatman 135). Despite Bukatman's insight on an extended fractal of differential scales, he applies a second theory of chaos studies' influence on *Blade Runner* quite narrowly. He includes only the architectural forms that duplicate themselves at each scalar level in the city. But, the influence of fractal geometry on this film extends beyond formulating the complexity of urban sprawl. The patterns of fractal geometry represented here also map the evolution of human and machine while at the same time mapping the conditions that prevent them from absorbing each other.

(2)

The exposition of fractal geometry and the broader field of chaos studies are important in the overall arc of argument in this dissertation since, contrary to its totalizing theoretical aspirations, in its portrayal in *Blade Runner* the repeating patterns of fractal geometry to which Bukatman refers ironically demonstrate how biological and technological systems are not enveloped in these patterns. Despite the apparent efficiency of the model, fractal geometry depicts the relation of bodies and machines in *Blade Runner* as inefficient, resisting complete fusion. Chaos studies, of which fractal geometry is a part, focus on conditions of chaos that were once considered meaningless, but are now considered to present high levels of complexity for which the scientist has not yet discovered the algorithm. Spontaneously organized, these systems ostensibly self-organize at particular thresholds across scales ranging from the sub-atomic to planetary. In his essay "Nonorganic Life," theorist Manuel DeLanda describes these spontaneous events of self-organization "as though 'inert' matter, confronted with a problem stated in terms of a balance of forces, spontaneously generates a machinelike solution by drawing from a 'reservoir' of abstract mathematical mechanisms" (DeLanda, *NL* 135).[18] Theorists in this field call these spontaneous solutions "singularities," critical points in a turbulent flow where the material re-organizes itself, causing it to change direction or alter its material state.

One of several examples DeLanda offers of singularities manifesting themselves in a "natural materiality" is the altered states water passes through as it warms and cools. As the temperature moves through a range of non-singular points the water remains relatively stable. At a certain critical value, however, (0 degrees Centigrade) the molecules of the fluid simultaneously re-organize, causing the fluid to take on crystal formations (DeLanda *W* 15). Similar spontaneous co-operation takes place in assemblies of chemical clocks, "chemical reactions in which billions of molecules suddenly begin to oscillate coherently" (DeLanda *W* 18). Scientists Prigogene and Stengers detail this phenomenon as follows:

> Suppose we have two kinds of molecules [in a vessel], 'red' and 'blue.' Because of the chaotic motion of the molecules, we would expect that at [any] given moment . . . the vessel would appear to us 'violet,' with occasional irregular flashes of 'red' and 'blue.' However, this is not what happens with a chemical clock; here the system is all blue, then it abruptly changes its colour to red, then again to blue. Such a degree of order stemming from the activity of billions of molecules seems incredible, and indeed, if chemical clocks had not been observed no one would believe that such a process is possible. To change colour all at once, molecules must have a way to 'communicate'. (Prigogene and Stengers 148)

Chaos theorists make the further move of linking the organic and machinic condition by noting that chemical clocks perform their spontaneous self-organization along singular points within the human body as well:

> An important chemical reaction in our own metabolism, which serves to transform glucose into useful energy (*glycosis*), has been shown to generate spontaneously rhythmic oscillations . . . it seems that our bodies are inhabited as much by the phenomena of 'nonorganic life' as by the more familiar phenomena of organic life. (DeLanda *NL* 133)

Chaos theorists postulate therefore that the mechanisms organizing both organic and non-organic matter, the human and the machinic, perform on the same continuum, which Deleuze and Guattari call a "machinic phylum." Their well-known formulation describes "an abstract reservoir of machine-like solutions common to physical systems diverse as clouds, flames, rivers and even the phylogenetic lineages of living creatures . . . In short, there is a single machinic phylum for all the different living and nonliving phylogenetic lineages" (Deleuze and Guattari 409). Deleuze and Guattari thus appropriate the principles of fractal geometry because the potential link that fractals create between machinic and organic phyla also challenges the idea of metaphysical presence that had accompanied humanist conceptions of subjectivity. Indeed, many supporters of posthumanism could fit into this camp.

Though DeLanda concedes that several scientists do not agree with the broad application of "singularities" across a range of disciplines (DeLanda *NL* 18), his advocacy of a metaphoric transfer from science to postmodern thought does enjoy notable support. For example, James Gleick's *Chaos: A New Theory of Science* explicates the complex, even seemingly illogical applications of fractal geometry and chaos theory for the complex organization of turbulent flow in the design of aircraft, turbine engines, propellers, submarine hulls, and "other shapes that move through fluids" (Gleick 122). Gleick continues: "In theory the World War II atomic bomb project was a problem in nuclear physics. In reality the nuclear physics had been mostly solved before the project began, and the business that occupied the scientists assembled at Los Alamos was a problem in fluid dynamics" (Gleick 122). Similarly, in *Fractals: The Patterns of Chaos*, scientist John Briggs finds singularities organizing structures as diverse as cauliflower, a shoreline, and lymph ganglia in the human body. Deleuze and Guattari also draw on the model of singularities at times, suggesting that this model metaphorically helps differentiate human consciousness: "Far from being individual or personal, singularities preside over the genesis of individuals and persons . . . either singularities already comprised in individuals, or the undifferentiated abyss" (Deleuze and Guattari 103). We can see that the model of singularity in chaos theory receives broad application, so that it appears to offer an explanation for all behaviour, both human and non-human. DeLanda broadens the applications of fractal geometry as much as possible to include the possibility of non-organic structures "expressing" themselves through their periodic oscillations. As he states, "Matter, it turns out, can 'express' itself in complex and creative ways, and our awareness of this must be incorporated into any future materialist philosophy" (DeLanda *NL* 133). Thus the fractal geometric patterns in *Blade Runner* I read, in DeLanda's term, as "expressions" that intentionally blur the boundary between organic and non-organic life forms. However, I contend that this blurred boundary does not enable a complete, efficient linking of the organic and non-organic in this film.

Despite the popularity of fractal geometry for posthumanists to explain the merger of bodies and machines, several theorists speak against this model, particularly because of its totalizing aspirations. For example, philosophy scholars Carl Matheson and Evan Kirchhoff astutely criticize the enthusiasm with which chaos theory was greeted late in the twentieth-century:

> Chaos theory was the intellectual darling of pop-science writers of the late 1980's. In their eyes, it would provide a new paradigm by which to describe the world, one that liberated scientists from clockwork determinism — or, alternatively, from incomprehensible randomness. In an introductory textbook of the period, Robert Devaney called chaos theory "the third great scientific revolution of the twentieth century, along with relativity and quantum mechanics." Similar attitudes propagated into philosophy; for example, Stephen Kellert argued that an acceptance of chaos theory would involve a reconfiguration of scientific methodology. (Matheson and Kirchhoff)

Their discussion challenges the stabilizing effect that fractal geometry was supposed to produce for posthumanist thinkers. Their citation of Kathryn Hayles's belief that the "concept of order has undergone a 'radical reevaluation' in recent decades," emphasizes my argument for the presumed significance of fractal geometry as an interpretive metaphor among certain scholars. Matheson and Kirchhoff argue, however that

> [Hayles] attempts to establish a parallel between chaos theory and various poststructuralist philosophical positions, including those of Derrida and Foucault, claiming that this new paradigm 'may well prove to be as important to the second half of the century as the field concept was to the first half" (*CB*, p. xiii), and that chaos may soon be "on a par with evolution, relativity, and quantum mechanics in its impact on the culture." (Matheson and Kirchhoff)

After discussing the various ways chaos theory failed to affect the predicted widespread paradigmatic shifts, Matheson and Kirchhoff conclude that the theory was flawed for at least three reasons:

> First, chaos theory does not constitute a scientific revolution of sufficient magnitude to effect wholesale changes in our conceptual scheme. Second, the similarities between chaos theory and modern critical theory are few and vague. Third, the applications of chaos theory to specific works of literature have been forced and un-illuminating. (Matheson and Kirchhoff)

Despite their criticism of "applications of chaos theory to specific works of literature," the fractal patterns that characterize chaos theory offer the most revealing approach to the filmic narrative of *Blade Runner* here. They are pertinent, not only because of chaos theory's popularity when the movie was filmed (1982), but also because fractal geometry ironically shows why the fusion of the machinic and the human is in fact never complete, serving the opposite function to that intended by posthumanists such as Kathryn Hayles. In *Blade Runner* the two conditions of technology and biology do not offer up the "wholesale transfer of bio-logic into machines"; instead, the representation of the posthuman *episteme* shows the disjunction of carbon and silicon without ever fully resolving the two. Cyborgian entities are not able to achieve the efficient functionality that chaos theory had predicted.

(3)

The dystopian feel of Los Angeles, 2019 that *Blade Runner* portrays, with its towering buildings, its dim light and its teeming crowds, undermines any celebratory valorization that posthumanists would read into the film's recurring fractal patterns: that the merger of machine and human contributes to a better world. Indeed, the landscape of *Blade Runner* shows that a rational machinic model can produce unreasonable results when applied to human experience. Though Descartes' model of individual subjectivity involved the human subject reasoning in solitude, *Blade Runner* – through the autocratic figure of Tyrell – shows how this rational practice can culminate in the subject's loss of solitude, as citizens and replicants alike become submerged beneath a sea of code, beneath the repetitive, ruthless logic of machines passing overhead. Ironically, the most significant characters in the film take the form of advanced technology and the human subjects are relegated to street level, as a river of faces flowing past.

Blade Runner dramatizes the sense of malaise generated by the spread of technological forms. This theme is fully presented when the most advanced of the replicants, Roy Baty, a Nexus 6 generation from the Tyrell Corporation, requests to have the parameters of his life span extended by Tyrell. Their conversation about life spans stays with elemental questions of life and death, but these for Tyrell are found in the discourse of chaos theory. He tells Baty that his 'generation' of replicant consists of an "organic life system [whose] coding sequence cannot be revised once established." Baty responds on a similarly fundamental level by asking whether the recombination of his chemicals might resolve the problem of his mortality.

Yet as the film progresses, this sense of technological determinism on every social level becomes blurred by the replicants' sense of "interiority." Although this model would appear to recall metaphysical humanist structures once again (perhaps as the kind of machinic ideal Hayles holds out), their condition as technologies also merges with this interiority. This modelling of "non-organic life" surfaces again when the viewer looks at the 'blood' of the dead Priss, lying stiffly, doll-like, on the floor. Her gunshot wounds appear to leak more than bleed, and have the gloss and viscosity of hydraulic fluid. Her interiority remains mysterious not because a "ghost in the machine" maintains her integrity as a unified subject from some hidden depth, but because her interiority remains technologically mysterious. Tyrell is unable to alter the "coding sequence" of the "organic life system" without causing a "virus" to propagate and cause the whole system to crash. Even the creator does not know everything about his creation.

Baty's responses to Tyrell extend this motif of the machine's mystical interior, but only ironically. When he states, "It isn't an easy thing to meet your maker," he parodies the metaphysical claims of Christianity. "Maker" carries the metaphysical overtones of a spiritual creator, but refers simply to Tyrell as the businessman who invented him. Furthermore, Baty's request for "more life" suggests, on one level, the Christian belief in eternal life but still narratively returns us to his own materiality: the abstract quality, "life,' built in Baty's case from component parts. Finally, Tyrell's reference to Baty as a prodigal son does not simply refer to his rebellious actions. When he confesses to Tyrell that he has "done things," the scene appears to repeat the moment of absolution described in the Biblical text. Only here the roles are reversed. The son acts nobly in defense of his "race" of slaves; the father enslaves his progeny in the frontiers of off-world colonies. In this era technology has developed even a sense of spiritual interiority, but this interiority remains unattached to a code, either scriptural or technological. Here the synthetic prodigal son kills his father and remains unpunished.

This bleak sense of technological determinism is further challenged when the scene shifts to J. F. Sebastian's apartment. He "makes friends" by inventing a broad range of organic life systems for the Tyrell Corporation. In Sebastian's apartment the range of life systems that laugh, spin, walk around, play chess suggests a continuum of material potentialities in the technologies themselves instead of an opposition between human and machine that proceeds inexorably until some teleological absorption. This continuum extends from the automata who welcome Sebastian home and then march into a door-frame, to the highly "evolved" couple, Baty and Priss. The humans who enter the apartment, Sebastian, who is ill, and later Deckard, who is hunting, do not appear to be nearly as emotionally and physically complex as these other life systems. Sebastian's admission that "there's some of me in you" suggests that the boundary between the machine and the body is not so distinct after all. It might also indicate that Baty and Priss are in fact more "advanced" than he, even though he built them. When Sebastian patronizes them, treating them like one of his other "toys" (there is a prurient sexual subtext in his request for them to "show him something"), Baty rebukes him by telling him that they are "alive" too.

In *Blade Runner's* world, where the superior technology is officially classed as a slave, and has become human enough to desire freedom from the inferior class of humans, the importance of eye-sight to protect the interests of the human against the machine becomes magnified. The disembodied, unblinking eye that flashes onto the screen briefly as the camera begins its descent into the city introduces this visual motif at the film's outset. References to sight, to sightings, proliferate throughout *Blade Runner*: in Deckard's career as a "detective," in the lenses and microscopes, the photo enhancer, photographs, and screens. All suggest that the government's anxiety that is propelling Deckard's hunt for the replicants stems from their threat to the power balance which keeps human subjectivity dominant, in the Platonic sense advocated by Roger Penrose, over all forms of life, organic and non-organic. Even though Deckard's dreams suggest he is a replicant, his mission is nonetheless funded by the (human) police and emphasizes the importance of the replicants present to the established 'order' of the city.

The smoothness of the camera's descent into the city introduces a trope that circulates throughout *Blade Runner*, that of flow. From this slow glide through space, to the flow of pedestrians on the street, to the flight of the police "plane" carrying Deckard to the port on the top of the police building, to the artificial voice telling pedestrians to "move on" after Deckard chases and shoots a replicant, the bottom line for survival in this condensed environment seems to be "keep moving." The exteriorized organic body obtains metaphorically in the city traffic, its moving figures the corpuscular flow of the city's arteries. The metaphor of the body works on the scale of the city, but no longer applies to actual bodies. These are calibrated now for survival, hard-shelled and hollowed out. Theweleit's exhaustive study of the Freikorps notes how flow identifies itself ambivalently with the feminine other which the masculine body wishes to both armor against and dissolve (passionately) into. According to Theweleit, " . . . the ideal man of the conservative utopia [is a] man with machine-like periphery, whose interior has lost its meaning . . . whose physique has been machinized, his psyche eliminated – or in part displaced into his body armor. We are presented with a robot that can tell the time, find the North, stand his ground over a red-hot machine gun, or cut wire without a sound . . . His knowledge of being able to do what he does is his only consciousness of self" (Theweleit 162). When Deckard kills his first replicant, whose soft skin and breasts the camera shows as she showers, he appears to have become machinic in order to steel himself against having to shoot beings who are more like himself than he is. Deckard's spitting blood into a sink of running water after the replicant, Rachel, saves his life, might serve as a sign of his interiority returning him to the dis-armed state, in the "soft" condition of the lover as he leaves with her.

Ironically, it is the condition of flow that identifies him, not with the too-human feminine body, but with the inhuman replicant. Again the categories that would distinguish machine from human are erased. Both Priss and Leon, at different points, put their hands in containers of water at extreme temperatures. Baty licks the fluid which oozes from Priss's body after she is shot by Deckard, a show of tenderness to her corpse which Deckard has not yet demonstrated to anyone alive. Rachel, Tyrell's latest synthetic experiment, weeps in Deckard's apartment (Rachel weeping in this case for children she will not have). Deckard's final showdown with Roy in Sebastian's apartment takes place in the rain, and it appears as if the inert building (a technology as well) weeps in sympathy for the replicants. The water seems to be Baty's element, this convergence of the elements and the hunt arousing something primitive in his wolf-like howls. Deckard, out of his element, would have died from slipping off a wet iron beam had Roy not hoisted him onto the flat surface of the roof. Baty's final words reverse his relation to the machinic, associating him with flow once again. The memories that will go with him at his death, he says, will be "moments lost in time, like tears in the rain."

Philip K. Dick's book, *Do Androids Dream of Electric Sheep?*, the source for the film, presents Deckard's bounty-hunting for "andys" with his yearning for biological life. Biological life, in Dick's telling, is steadily falling into extinction, species by species. The "more human than human' motto of the Tyrell Corporation in this text produces an Edenic nostalgia for a time when the organic had not been displaced by the merely machinic. Near the end of the story Deckard discovers a toad, and since he has paid close attention to his "Sidney's order catalogue of genuine animals," decides to bring the creature home to surprise his wife. "It's like being a kid again," he thinks (Dick 238). When his wife finds a control panel in its abdomen, Deckard is crestfallen: "'I'll be okay.' He shook his head, as if trying to clear it, still bewildered. 'The spider Mercer gave the chickenhead Isidore; it probably was artificial, too. But it doesn't matter. The electric things have their lives, too'" (Dick 241). Distinguishing the technological from the biological, for the Deckard of *Androids*, ensures the vitality of the world, but ironically this is vitality only in the limited organic sense.

Despite the fact that a technological imperative appears to link machines and humans in *Blade Runner*, the gulf between the technological and biological forms of life grows as Deckard's detective work proceeds. His search for the machines (forced retirement here: making sure they stop working), 'protects' the earth from their superior vitality. These beings are indeed "more human than human"; detecting them requires performing a test of up to a hundred questions with the use of a lens which magnifies the pupil of the individual being tested. If the subjects do not give an involuntary sympathy response, they are guilty of not living by biological means. In showing no affect, much like Deckard in fact, they give themselves away. The gaze is always one way, from Deckard on out. But as Rachel says, Deckard probably would fail his own test, hinting at Deckard's own technological genealogy.

However, even the presence of this sympathy response test to detect the replicants does not permit a final resolved reading of these advanced technological forms, as cold, overly rational, indeed mechanical beings. Even though they fail this test of appropriate emotional response, the replicants are the only ones who show emotion, have dreams, and make plans for the future. Human reason comes full circle (to suggest and erase a metaphysical metaphor): reason has been applied so thoroughly to the replicants' systems that they themselves enjoy non-rational knowledge. Professor of Film and Philosophy Stephen T. Asma also notes the centrality of issues surrounding reason in *Blade Runner*. He writes:

> The implications for knowledge theories (epistemology) in *Blade Runner* are extensive. Many of Descartes' problems of skepticism (and those of Modern philosophy generally) are raised throughout the film. *Blade Runner* highlights questions of certainty in the same way that the literature of hallucination throws doubt upon truth in perception. Knowledge, for Descartes, is defined in terms of foundational certainty and this certainty is lacking in every belief that is capable of doubt. Thus radical skepticism takes root in claims for knowledge of the external world and of our selves. The senses are incapable of delivering up indubitable certainty. Films like *Blade Runner*, *Total Recall*, *Proof* and *Jacob's Ladder* nicely illustrate the blurred lines between waking consciousness, dream states and other altered states of perception. (Asma)

The collapsing distinction between Deckard and Baty stirs up patterns of turbulence in *Blade Runner* that remain unsettled to the end. Since he hunts one of his 'own', Deckard's personal motivations for this hunt become confused. Is he also just trying to survive, as are the others? His position as a hunter hunting remains intact throughout the film, until the final scene in Sebastian's room where the flow of the gaze is reversed. When Baty searches for Deckard in a 'game' of hide and seek, he again displays his super-human qualities, since Deckard seems weaker, and closer to the human. Good/bad binaries are reversed as Roy knocks Deckard's gun from his hand in order to make the game more "sportsman-like." Without weapons Baty has the advantage, uncannily able to "see" with a sixth sense, grabbing Deckard's hand through a wall, and battering his head between the bathroom water taps into the room in which Deckard is hiding. Baty taunts Deckard about being able to see him, less interested in the capture than in the chase. His final words to Deckard on the top of the roof, recounting the images which will die with him, gesture back to his words to the scientist in the eye lab: "If only you had seen what I've seen with your eyes." Despite being an off-world replicant, Baty's range of experiences is much broader than Deckard's, and he is able to understand their significance as moments of particular beauty. Baty's superior vision serves as a metaphor for his deeper level of insight. In the category of cops and criminals, Baty's termination (less a death than a cessation of movement) has more dignity about it than does Deckard's ongoing life. The bodies evolving on the machinic phylum with non-organic materials seem to be better suited, thriving, in the condensed spaces and hardened surfaces of the post-millennial city.

By the end of *Blade Runner* the machinic/organic distinction has expanded still further. Despite the permeation of the structures of the city with the self-organizing determinist patterns of fractal geometry, the machines in fact enjoy superior mobility in crossing that urban space. Although Deckard can distinguish between the two with a simple lens, the significance of biology is subsumed by the superior power of Baty out-performing Deckard, reduced to scrambling for his own life. Larry McCaffery's comments regarding William Gibson's *Count Zero* apply equally here: "it's a fascinating evocation of a world in which humanity seems to be constantly outshone by the flash and appeal of the images and machines that increasingly seem to push people aside in their abstract dance toward progress and efficiency" (McCaffery 265). Deckard finally is seduced by Rachel's synthetic sophistication. Outside of his role as hunter, he ironically becomes more humane by siding with a synthetic.

Deckard's role as detective places him in an antagonistic relation with the replicants at the beginning of the movie. His role locates him in the story-frame of the pot-boiler, "[with its] hard-boiled detective formulas" as McCaffery notes. This story structure, functioning as an abstract technology, suitably shapes a narrative that does not permit the resolution of its oppositions, especially those of the human and the machine. The presence of replicants in this story structure indefinitely postpones the narrative closure of these oppositions. In the end, the "villain" does die, and the "hero" does get the girl, but beside her he appears to be merely human.

Chapter Five

Applying Gödelian Undecidability: Reading the Posthuman *Episteme* in Terry Gilliam's *Brazil*

Although McCaffery celebrated the "flash and appeal" of the machines in *Blade Runner*, director Terry Gilliam found this same technological flash and appeal offensive. In fact *Blade Runner's* positive ending in the studio release helped motivate him to make *Brazil*. In an interview with critic Terry McCabe, Gilliam states, " . . . I was trying to do what *Blade Runner* didn't do because it sold out in the end. The ending of *Brazil* is very much a reaction to *Blade Runner* because the ending of *Blade Runner* I hate" (McCabe 124).[19] Deckard's exit with Rachel at the end of the first *Blade Runner* demonstrates a technology that has 'advanced' to the point of supplanting the human, or the humane. By contrast, Lowry's 'exit' with Layton (Helpmann says, "He's got away from us" [Scene 155]) at the end of *Brazil* complicates this narrative of technological advancement. Instead of replacing the human with the soft machine, in *Brazil* the human proliferates alongside the machine, providing a second example of undecidability in the *episteme* of the posthuman. Paradoxically, the technocracy portrayed in *Brazil* functions optimally not when humans work efficiently, but when they work inefficiently, wasting time, making mistakes, and failing to correct them.

The terms "clean" and "dirty" provide useful categories for considering the ways that (clean) machines function alongside (dirty) people in *Brazil*. Although greater value tends to be placed on "clean" in a history of these terms,[20] in this film the machine does not attempt to clean up the actions of society, making them more consistent and disciplined workers. In this sense, critic R. D. Erlich's statement, that *Brazil's* importance lies in its depiction "of the imposition of the mechanical and electronic upon the human and the use of that image as a metaphor for bureaucratization" (Erlich), is not so much wrong as it is not right enough. Many dystopian narratives show the relation of a technologized bureaucracy exercising control over the population in the way that Erlich describes. Indeed, the year prior to *Brazil's* release (1985), a movie version of George Orwell's *1984* had just come out. Shortly after this, a movie version of Margaret Atwood's *A Handmaid's Tale* was also released (1989). *Brazil* distinguishes itself from these narratives by portraying a government 'machine' that does *not* impose discipline on its workers, but instead benefits from their tawdriness.

The opening sequence in *Brazil* establishes the significance of clean and dirty conditions that then infiltrate the other as the movie proceeds. Although the first collision of dirty biology with clean technology takes place accidentally, it in fact determines the narrative's trajectory. The screenplay describes this scene:

> The BEETLE's career comes to a halt . . . squashed flat on the brilliantly clean ceiling . . . or has it? As the TECHNICIAN clambers down from the rickety heights, the BEETLE's carcass comes unstuck from the ceiling and drops silently into the typewriting machine which hiccoughs, hesitates and then types the letter "B" and hesitates and then continues so that the next name is BUTTLE, Archibald.
>
> The TECHNICIAN fails to notice this and the machine continues smoothly TUTWOOD, Thomas T . . . TUZCZLOW, Peter . . . (Scene 13)

The intrusion of the bug's juices into the typewriter keys trips the security mechanism of the government agency. Immediately following this data entry the camera shows the raid on Archibald Buttle's home, instead of Tuttle's, while his family enjoys a pre-Christmas evening of stories (Scene 19). Many elements of the movie that follow Buttle's arrest are similarly organized by the opposition of clean and dirt. One could cite the Buttles' cluttered apartment in relation to the monolithic architecture of Information Retrieval, the woman whose dog runs around with its bum taped shut while she scolds Sam for littering, Spoor's white protective suit filling with human waste, Mrs. Terrain's ravaged body splashing from the coffin in the sanitized funeral parlor, Sam's dreams of flying in relation to waking in an overheating apartment, or Lint's face bloodied by bullets while operating on Lowry. The terrorists who detonate bombs three times in the movie attack the technocracy on these same lines, creating a chaos of dismembered bodies among the docile Christmas shoppers and diners. When Warren scolds Lowry near the end of the film, that an "empty desk is an efficient desk," he restates this juxtaposition, and initially appears to validate Erlich's assessment of a mechanical bureaucracy imposing itself over the population it manages in *Brazil.*

Portraying an efficient bureaucracy as imposing its disciplinary measures over the unruly masses has a rich history. In a section entitled "Work and Hygiene," scholar Anson Rabinbach describes how social reformers increasingly appealed to cleansing properties of work from the middle to late nineteenth century. He writes:

> Toward the end of the nineteenth century, idleness began to wane as the predominant mode of conceptualizing resistance to labor. The reasons for this decline can be enumerated: the old Christian proscription on idleness was losing its appeal for urban workers and industrialists; the technology of the factory system required more than externally imposed discipline and direction, but rather an internally regulated body ancillary to the machine. Consequently, the ideal of a worker guided by either spiritual authority or direct control and surveillance gave way to the image of a body directed by its own internal mechanisms, a human "motor." (Rabinbach 35)

He continues his discussion about the internalization of mechanical metaphors that meshed with the factory machines where workers were employed by considering the role that conceptions of cleanliness played in making this metaphor effective. During the Victorian period, traditional Christian teachings that linked cleanliness with moral practice were losing their influence in the face of teachings from medical science that linked cleanliness with machine-like efficiency and productivity.

> To be sure, moralizing writers continued to condemn idleness and to write about the virtues of work . . . Though the change is halting at first, this new literature by work-hygienists considered the physiological and moral qualities of work as complementary -- each aspect balancing and reinforcing the other to create an internal equilibrium between the needs of the body and the soul, an economy of physiology and morality . . . In 1862, Apollinaire Bourchardat, professor of hygiene at the faculty of medicine at the University of Paris, warned an audience of skilled workers who attended lectures at the Association Polytechnique on the harmful physiological effects of work. Science, Bourchardat claimed, could now offer irrefutable proof of labour as 'a condition of health, of morality, and of indefinite progress'. (Rabinbach 36)

If "indefinite progress" were too abstract an incentive, at least the "condition of health" would offer a more concrete goal.

Around the turn of the century and in the years leading up to the first world war, ideas that linked work, machines and cleanliness were given another spin by the industrial engineer, Frederick Winslow Taylor. Making an appeal that Rabinbach says was "profoundly modernist," Taylor promised to "emancipate industry and technology from the inhibitions and prejudices of tradition and class conflict" (Rabinbach 238). Taylor's approach aimed to reduce the power that labour unions were gaining in factories, by devising a system for organizing the work process according to "scientific principles" that eliminated wasted time and materials. *Brazil* likewise describes a society that has become saturated with an economic argument that is similar to Taylor's. Here the accused are encouraged to confess quickly since the government recovers its expenses by charging them for time and services that they use. Mr. Helpmann states in an early interview:

> That is why we always insist on the principle of Information Retrieval Charges. These terrorists are not pulling their weight, and it's absolutely right and fair that those found guilty should pay for their periods of detention and the Information Retrieval Procedures used in their interrogation. (Scene 3)

In the factory, Taylor cleaned up work practices by establishing shop rules that restricted the amount of time the workers could use for breaks in order to maximize the productivity of the work force. By applying strictly rational principles, Taylor hoped to "increase productivity and eliminate the waste of labour power and materials" (Rabinbach 239). These rational principles were applied by breaking down the construction process into its component stages:

> 1.) the division of all shop-floor tasks into their fundamental parts; 2.) the analysis and design of each task to achieve maximum efficiency and ease of imitation; 3.) the redesign of tools and machines as standardized models; 4.) the linking of wages to output; and 5.) rational coordination and administration of production. (Rabinbach 239)

Although, as geographer David Harvey suggests, it would be dangerous to over-simplify the complex cultural influences of especially the modernist period,[21] we could note the influence of machines as metaphors for productivity and efficiency throughout this time. Together with Taylor's rationalization of labour time to its component parts, Pound's 'Vorticist manifesto' likens "pure language to efficient machine technology" (Harvey 28) and the Bauhaus architects, such as Le Corbusier (1887 - 1969), Ludwig Mies van der Rohe (1886 - 1969) and Walter Gropius (1883 - 1969), "embraced rationalization as a 'purifying agency' which would strip away meaningless ornament in order to construct buildings which would be effective because of their functional simplicity," according to critic Nigel Wheale (Wheale 39). Indeed, Le Corbusier's phrase, that houses were "machines for modern living," re-emphasizes the connection being drawn here, between cleanliness, functionality and mechanism. This connection is underscored in the scenes in *Brazil* that take place in Lowry's apartment. These were filmed at an apartment building in Paris, called the Arena Apartments in *Marne la Vallée*, and designed by postmodern architect Ricardo Bofill (Cowen). Although this 1980's building exemplifies postmodern architecture, with its fragmented architectural styles, the inside of Lowry's own apartment exemplifies the modernist ideal of a spare, automated living environment that requires a minimum of human engagement. According to the stage directions:

> . . . we have had a chance to get a glimpse of SAM's flat. It is functional, soulless and, though neat, has not been assembled with a loving hand. Most of the furnishings are built in. The walls are divided into two-foot square metal panels painted a non-committal colour. Certain of the wall panels have Central Services logos on them with the admonition "Do not obstruct or remove" below. SAM has livened his bedroom up with large and colorful film posters. The sitting room sports several framed pictures of wide beautiful vistas. (Scene 24)

The movie shows what happens when a glitch enters the works, though, with Lowry's apartment springing to life only after he gets the ringer on his clock to activate with the time-honoured technique of a pat and a shake. His shower then spits water, his closet displays clothes, the toaster toasts and coffee-maker coffees, all without him lifting a finger. However, the coffee-maker pours the brew over the toast, and later the heating system overheats his apartment, problems that are complicated by the fact that even the 'on/off' switches are automated. Lowry cannot turn the heat off, but must wait for government technicians to arrive.

It would be convenient to continue working with this model, where the term 'clean' ostensibly aligns with technology, and 'dirty' with biology. Of course these categories apply in more complicated ways than this binary, since even a moment's reflection recalls examples of their reverse application. Environmentalist groups such as the Sierra Club and Greenpeace, for example, view technology's encroachment on natural spaces as sullying their pristine purity.[22] The relation of 'clean' and 'dirty' as coherent categories is further complicated when we recall the pro-technology rhetoric of industrialists in the late nineteenth century, who saw machinery and nature as functioning in harmony with each other. From their viewpoint, as historian David Nye states, nature could be made to serve human needs through the mediation of technology, but these three categories, nature/human/technology, could operate without harming any of the others: " . . . [pro-technology industrialists] believed hopefully that mechanical improvements would be harmonious with nature" (Nye 38).[23] Nye continues by quoting one George S. White, "an apologist for industrialization," who writes in 1836:

> Let our legislators be assured, that while they are extending towards its completion that system of improvement planned and hitherto carried forward with so much wisdom, they are putting into operation a moral machine which, in proportion as it facilitates a

> constant and rapid communication between all parts of our land, tends most effectually to perfect the civilization, and elevate the moral character of the people. (in Nye 39)

The "systems of improvement" that the governing bodies put in place not only facilitate increased communication by re-shaping the wild spaces of nature, they also ostensibly contribute to more abstract improvements in the well-being of society.

However, White's statements do not consider the detrimental effects that also grow out of technology's proximity to nature. Like White, nineteenth century philosopher Ralph Waldo Emerson, in his essay "The Poet," further emphasizes that the integration of machines with nature results in a clean transfer of value. As Nye explains,

> In 'The Poet' Emerson chided his contemporaries for thinking that industrialization was not in harmony with the landscape: 'Readers of poetry see the factory-village and the railway, and fancy that the poetry of the landscape is broken up by these; for these works of art are not yet consecrated by their reading; but the poet sees them fall within the great Order not less than the beehive or the spider's geometrical web. Nature adopts them very fast into her vital circles, and the gliding train of cars she loves like her own'. (Nye 61)

In Emerson's view, technology and nature integrate cleanly, but apparently only a poet's sensibility will enable one to recognize that both demonstrate artistry: technology the artistry of humanity and nature the artistry of God.[24] By contrast, Gilliam's late twentieth century vision does not share Emerson's optimistic view of technology's integration with nature. Instead it shows how nature has been blighted with industrial waste. When Sam rides with Layton outside the city to pick up some freight, the camera initially shows outdoor scenery speeding past the truck. As the camera rises to give a more panoramic view, the viewer might expect to see a classic natural vista, contrasting with the close, cluttered urban spaces that have characterized the movie to this point. Instead, the viewer notices that the nature scenes were only painted on billboards that line the highway. Behind them lies a landscape that has been poisoned by massive factories like the one they visit. Screenplay:

> We PULL BACK and lift off to see that the beautiful countryside through which we've been travelling is in fact a solid wall of giant bill-boards, advertising all sorts of wonders like pine scented lavatory paper, sea spray flavored cigarettes – you name it – These advertisements form an unbroken corridor down which the road travels. From a bird's eye POV we see that the land behind the hoardings is blasted and blighted with garbage etc.
>
> 87 EXT. POWER PLANT DAY (LATE AFTERNOON)
>
> The power plant is an extensive, brutal, Dante's Inferno of a landscape made mainly of steel ... towers, chimneys, huge pipes, buildings which look like bomb shelters ... It is still daylight but the whole scene is murky and forbidding because of the swirling steam and smoke. In the murk can be seen sinister-looking FIGURES in protective clothing and hard hats. This is the world which is now entered by JILL's lorry . . . The lorry halts at a dispatching hut near the crane and JILL jumps down from the cab. (Scenes 86, 87)

The factories' harmful effects, poisoning the landscape for as far as the eye can see, also represent the far-reaching effects of the government technocracy in monitoring its subjects. When Lowry tells Layton that they should "get out of here," she replies, "there's nowhere to go."

A discussion of the relation between images of cleanliness and dirtiness in technology and nature would quickly go farther afield than is needed for a reading of undecidability in Gilliam's *Brazil*. This brief discussion is intended to show that however this relation is configured, discussions involving the relation of technology to nature often invoke cleanliness and dirt as a way to clarify those discussions. Despite the range of relationships between technology and nature that are proposed by various writers, however, none considers the possibility that technology, abstract or concrete, could function optimally not because of its potential to conserve energy, but because of its potential to waste energy. Despite significant philosophical differences between himself and the nineteenth century authors mentioned here, Foucault, like them, does not consider that more abstract social structures might also waste energy when he discusses the management of populations, not in factories, but in hospitals and prisons. Unlike Taylor and Ford's modernist enterprise of creating a monolithic corporate structure that could solidify control of labour for economic interests, Foucault's postmodern project emphasizes "discontinuity and difference in history and privileges 'polymorphous correlations in place of simple or complex causality'" (Harvey 8). In Foucault's formulation, discontinuity in history results from shifts in *epistemes* that are shaped by complex relations of power, taking place apart from human agency, thus undermining modernist conceptions of the progressive humanist subject. Foucault therefore draws on the language of mechanism to show how relays of power operate independent of human intervention. This language surfaces in his discussion of Europe's response to the plague:

> The plague is met by order; its function is to sort out every possible confusion: that of the disease, which is transmitted when bodies are mixed together; that of the devil, which is increased when fear and death overcome prohibitions . . . Against the plague, which is a

> mixture, discipline brings into play its power, which is one of analysis. A whole literary fiction of the festival grew up around the plague: suspended laws, lifted prohibitions, the frenzy of passing time, bodies mingling together without respect, individuals unmasked, abandoning their statutory identity and the figure under which they had been recognized, allowing a quite different truth to appear. But there was also a political dream of the plague, which was exactly its reverse: not the collective festival, but strict divisions; not laws transgressed, but the penetration of regulation into even the smallest details of everyday life through the mediation of the complete hierarchy that assured the capillary functioning of power; not masks that were put on and taken off, but the assignment to each individual of his 'true' name, his 'true' place, his 'true' body, his 'true' disease. The plague as a form, at once real and imaginary, of disorder had as its medical and political correlative discipline. Behind the disciplinary mechanisms can be read the haunting memory of 'contagions', of the plague, of rebellions, crimes, vagabondage, desertions, people who appear and disappear, live and die in disorder. (Foucault DP 197)

According to Foucault, the disciplinary mechanisms that helped order, or clean up, the disease-ridden parts of the city transferred smoothly to the disciplinary mechanisms that helped order the criminal elements in the city as well. Foucault's well-known discussion of Jeremy Bentham's Panopticon works the language of the clean machine to show how results could be achieved regardless of who operated the disciplinary technology:

> [The Panopticon] is an important mechanism, for it automatizes and disindividualizes power. Power has its principle not so much in a

> person as in a certain concerted distribution of bodies, surfaces, lights, gazes; in an arrangement whose internal mechanisms produce the relation in which individuals are caught up . . . Any individual, taken almost at random, can operate the machine . . . The Panopticon is a marvelous machine which, whatever use one may wish to put it to, produces homogeneous effects of power. (Foucault DP 202)

The disciplinary machine that Foucault discusses operated on the basis of a simple architectural technology, preventing the prisoner from knowing when he was being watched by the warden.

When technological improvements are soldered into the disciplinary scheme, as William Bogard does in *The Simulation of Surveillance*, the model of an efficient disciplinary machine imposing itself over the teeming masses continues to operate. For Bogard, like Foucault, disciplinary technology distributes an astrigent force across society in order to reduce human waste produced by delinquency or boredom. In Bogard's binary model, the potential for waste rests with the people, and the necessity of regulating that waste rests with the technocracy. Bogard argues that increasingly sophisticated technologies that enhance vision paradoxically permit law enforcement personnel to conduct their work of ordering populations without the hassle of seeing people at all. Instead the system of cameras, circuits and databases compiles a profile, a "simulation," of the person being observed that in turn is read by inspectors. The practice of law enforcement officers in *Brazil* who view even events taking place in front of them through a monitor, illustrates the mediational role media plays in selecting targets for disciplinary action in the film.[25] According to Bogard, the dirty physical body is cleaned up in the monitoring process, because this process transforms it into a profile, a case, a computer file:

> . . . at the start of the modern age we begin to sense in Foucault how the "real" body as a focus of the normalizing gaze is surreptitiously doubled by the body as information, codes, probabilities – alongside the surveilled body, beside the corpse as a means of training students in diagnostic and surgical skills, yet another figure of the body double emerges and grows in the technological assemblages that develop down to the present day, a clean, sterilized body, a shadow figure inhabiting files and datadumps, a statistico-actuarial artifact that in the twentieth century becomes the means for linking political, scientific, and corporate-insurial discourses into a web of total domination. (Bogard 63)

Like Jill Layton's experience in *Brazil*, bodies that can be placed under surveillance at a distance by a data-gathering system can also be reduced to a series of codes that are interpretable within that system. The prevalence of media technology as a means of managing the population is shown in an early scene where Lowry discovers that the woman of his dreams actually lives in an apartment block in the same city. He is standing in the Ministry of Information lobby, speaking with an old friend, Jack Lint:

> As they have been talking, a nearby bank of closed circuit TV screens has been displaying shots of people entering the lobby. As each one enters the CAMERA ZOOMS IN TIGHT on their faces for a frozen CLOSE-UP. JILL has just entered and the CAMERA ZOOMS IN and freezes on her face. SAM happens to glance up at this moment. He is startled – the over-exposed TV image is the face of the GIRL FROM THE DREAM. The face is only there a few seconds before being replaced by another picture. SAM looks about to see where the GIRL is, but JILL, in overalls, has her back to him as she

> stands in the queue for the Information desk and so there is no-one even vaguely reminiscent of the DREAM GIRL. SAM decides he must have imagined it. Over this JACK has been talking.

After their conversation concludes, Lowry walks to the elevator and the cameras appear once again.

> As SAM heads off to the lift, he passes a group of MEN standing around a temporary TV monitor. Several of them are dressed in white lab coats. They are being explained the benefits of a new surveillance system by a salesman type. His assistant is operating the controls. On the monitor we can see JILL standing in the queue for the Information desk. The CAMERA appears to be tracking in on her.
>
> CUT TO JILL at top of queue with several forms in her hand. A strange prototype radio controlled camera on a wheeled base is whirring and clicking as it approaches her. Throughout the next sequence it pokes around JILL in an annoying manner - thrusting itself at her face, trying to see what is written on the forms, peering over her shoulder. (Scene 25)

Like this one, Layton's attempts to find her wrongfully arrested neighbour lead to her own arrest as a terrorist, because her persistence also fits the terrorist profile compiled by the security detail.

Both Foucault and Bogard's later reading of clean, disciplinary mechanisms and the chaotic populations they monitor assume a standard of efficiency in the operation of these mechanisms that the governing system in *Brazil* never attains. The architectural structure in Jeremy Bentham's Panopticon may cause the prisoner to internalize the disciplinary regime so that he behaves as if he were being regulated at all times. However, most prison systems could not blanket a space with a regulatory grid that operates everywhere at all times in the manner Foucault describes.[26] Therefore, in order to read the porous security system in *Brazil*, one could turn to theories that describe more porous models similar to that proposed by Gödel in his Undecidability Theorems. These models not only produce certain effects, but also extravagantly waste energy in the process.

Georges Bataille's theory of general economics describes such a model in *The Accursed Share*, whose form might be as fluid as the energy that circulates across the globe. Plotnitsky's introduction to Bataille's general economics sets his anti-epistemological (non-)model against the epistemological model of writers like Foucault, who theorize the (disciplinary, for example) operations of a restricted economy that always functions. Although Foucault's *Discipline and Punish* does describe the *epistemic* shifts and historic multiplicities that characterize postmodern thought, his work describes historical effects without addressing the possibility of dissipation or waste in the performance of those effects. As Plotnitsky states:

> More generally, the theories whose metaphorical models are based on classical physics – whether Newton's mechanics, classical statistical physics such as thermodynamics, special or general relativity, (some versions of) chaos theory, or more classically conceived quantum theories – appear to be restricted economies – *epistemologies* rather than *anti*-epistemologies. More recent examples would include Foucault's, Deleuze's . . . and Michel Serres's economies . . . Deleuze's analysis in *Foucault* shows how classical geometry and physics function in Foucault's economy. It can be shown, however, that Foucault's geometry of force is still a restricted economy, as are "geometries" developed in Deleuze's own

> works even though Deleuze uses complex mathematical models.
> (Plotnitsky R 18-19)

This brief discussion of Bataille's general economy will only touch on those aspects that can help initiate a reading of *Brazil*.[27] It is hoped that these gestures will show how *Brazil's* technocracy does not oppose itself to a human field, in the authoritarian model proposed by Foucault and Bogard, but instead participates in it as a general economy.[28] However, it should be noted that the purpose for turning to Bataille is not to demonstrate the degree to which *Brazil* simply exemplifies general economy; no doubt Gilliam has never encountered French literary theory, nor Bataille's writings. My discussion turns to Bataille, instead, as a way to avoid reductive readings that simply place the governing technocracy in a clear opposition to the human in *Brazil's* narrative. This brief review of general economic principles will lead to a discussion of Gilliam's complex representation of technology and the human.

One widely held stereotype about governments is that they waste resources and lack accountability. Indeed, this stereotype might also be simplistically applied to the government portrayed in *Brazil*. However, Bataille's conception of dissipation goes beyond the wasteful practices of the public service. His general economy offers a rationale for why both concrete and abstract mechanical structures might benefit, from operating not efficiently, but inefficiently. For Bataille, the model that exemplifies what he calls exuberant non-recoverable expenditure is that of the energy that circulates around the globe. Early in *The Accursed Share* he introduces this theory of expenditure:

> I will begin with a basic fact: The living organism, in a situation determined by the play of energy on the surface of the globe, ordinarily receives more energy than is necessary for maintaining life; the excess energy (wealth) can be used for the growth of a system

> (organism) . . . On the surface of the globe, for living matter in general, energy is always in excess; the question is always posed in terms of extravagance. (Bataille 21, 23)

Bataille begins outlining his theory of general economics by talking broadly about 'energy'. As volumes one, two and three proceed, however, his examples become more culturally specific, including the Aboriginal potlatch rituals and the U.S. reconstruction process following World War II. The heart of his theory, however, was influenced by recent discoveries in the field of thermodynamics. For example, he credits Georges Ambrosino, "Research director of the X-Ray Laboratory, without whom I could not have constructed this book," for helping with his general economic theory. In an early footnote, Bataille states, "Science is never the work of one man; it requires an exchange of views, a joint effort. This book is also in large part the work of Ambrosino. I personally regret that the atomic research in which he participates has removed him for a time, from research in 'general economy'" (Bataille AS 191). The thermodynamic principle on which Bataille relies most strongly is that of entropy, which, as is known, describes the tendency of any system to expend energy, returning ultimately to a state of equilibrium. Bataille applies this entropic principle not only to losses of energy in the physical environment, but also more abstractly to a range of operations throughout society. Plotnitsky discusses some implications of this theoretical application:

> Loss – depreciation – is inevitable for any "machine," whether a system of production and consumption of meaning or something else, or a nonsystem, contrasystem or any combination of these. In a general economy, there can be only such combinations, whatever the overt aims or claims . . . No given combination determines once and for all the entropy or energy potential of a given theory, field, rhetoric, metaphoric, and so on, or their ability to survive . . .

> Economy is a metaphor of energy; but all economies, theoretical, political, or other, are subject to entropy or that which necessitates the metaphor of entropy. (Plotnitsky *R* 303)

Thus, from Bataille's point of view, Foucault's description of the Panopticon falls under what he calls, by contrast, a "restricted economy," because for Foucault the Panopticon is a 'machine' that never expends waste, but efficiently applies its disciplinary mechanisms on its docile prison population. In the terms of thermodynamics, Foucault's Panopticon 'impossibly' sustains itself by self-consumption, like a *perpetuum mobile*, since his model does not admit outside energy sources or non-recoverable expenditures of excess force. Since Bataille's theory is being read alongside Gilliam's movie here, one might astutely argue that the government's charge against Lowry of wasting time and materials actually undermines the relevance of Bataille's model. To a certain extent that argument would be right. However, one *could* respond by citing the government's own record, since in the movie the government itself in fact has elevated wastefulness to an art form, has got it down to a science. Following Bataille, it could be argued therefore that the practice of wasting resources paradoxically enables the government in *Brazil* to operate at optimum levels since wasting resources has become intrinsic to government procedure. By the end of the movie, Lowry's apartment has been slowly destroyed, with wires, pipes and tubes protruding everywhere, by government certified plumbers who were called initially to fix a minor heating problem.

Indeed, one could enumerate many wasteful practices perpetrated by the government in order to increase productivity. Lowry's own arrest exemplifies this kind of 'productive' error. The list of misdemeanors of which he is accused re-counts (to narrate, to count, to give an account) the story that the viewer has just seen. The viewer recognizes that, of these alleged infractions, some have been taken out of context, some are exaggerations and the rest are false. That Lowry is offered no forum for his own defense has less significance in this reading than the vigor with which the government pursues its case against not only Lowry, but other citizens as well. Thus, "official A's" statement replays the film, but as if it were filtered through the lens of the government's regulatory system. In a sense the accusations show how *Brazil's* narrative has played on the government's closed circuit televisions that glow everywhere. Official A:

> 93/HKS/608, (Sam Lowry) you are charged with the following:
>
> - Passing confidential documents to unauthorized personnel – dossier/Gillian Layton.
> - Destroying Government property – indeterminate number of personnel carriers.
> - Taking possession under false pretences of said personnel carriers.
> - Forging the signature of the Head of Records, Third Department.
> - Attempting to misdirect Ministry funds, in the form of a cheque to A. Buttle, through unauthorized channels.
> - Tampering with Central Services supply ducts.
> - Employing unqualified suspected persons for this purpose.
> - Attempting to conceal a fugitive from justice.
> - Obstructing the forces of law and order in the exercise of their duty.
> - Giving aid and comfort to the enemies of society.
> - Bringing into disrepute the good name of the Government, and the standing within the community of the Department of Information Retrieval.
> - Attempting to disrupt the Ministry of Information Retrieval's internal communicating systems.

- Wasting Ministry time and paper.

One of several layers of irony in these accusations surfaces when Lowry, being one of their own, demonstrates expertise with technology. When Kurtzmann calls Lowry into his office to take care of Buttle's refund cheque, "SAM sits down at the console and punches keys. He does this very efficiently, muttering to himself and generally demonstrating an expertise which obviously leaves KURTZMANN way out of his depth . . ." (Scene 34). Although Lowry does perform tasks efficiently in the Department of Records, actually *saving* Ministry time and paper, his friend Jack Lint's comment indicates that Lowry has been 'slumming' there:

JACK

Sam, your life is going wrong – let your friends tell you - Records is a dead end department, no Security Level worth a damn, it's impossible to get noticed –

SAM

Yes, I know, fantastic, marvellous, wonderful - remember me to Alison - and the - er - twins.

JACK

Triplets.

SAM

Really? – God, how time flies! (Scene 25)

Although the government arrests Lowry because he has wasted resources, in fact the narrative shows that the government system in *Brazil* holds inefficiency in high regard.

Throughout the film, excessive amounts of paper circulate in Records and later in Information Retrieval, with vacuum tubes and clerks as conduits. The audience learns that many other departments such as Finance, Central Banking, Central Supply also depend on the steady circulation of these paper sheets. An early scene sets the stage for the steady flow of paper that follows:

> We come in on a CLOSE UP of a pink version of the RECEIPT being stamped and impaled on desk spike as we PULL OUT to reveal an infinite expanse of regularly arranged metal desks, each desk with a built-in TV console, and each (except one) occupied by a CLERK. Every desk is snowed under with pieces of paper much like the receipts seen in the previous scene. More papers are delivered to each desk intermittently by way of pneumatic tube. OFFICE BOYS bustle about with even more paperwork. From the back of the room we get a view of the screens which show graphs, tabulations, figures. (Scene 21)

Yet these attempts at thoroughness, shown by such intense record keeping, also contribute to the government's many errors. When Buttle is wrongfully arrested, the officer's recitation of document numbers and receipt codes suggests that his detainment has been initiated by a system operating with bloodless efficiency.

> OFFICIAL
>
> I hereby inform you under powers entrusted to me under Section 47, Paragraph 7 of Council Order Number, that Mr Buttle, Archibald, residing at 412 North Tower, Shangri La Towers, has been invited to assist the Ministry of Information with certain enquiries, the nature of which may be ascertained on application form BZ/ST/486/C fourteen days within this date, and that he is liable to certain obligations as specified in Council Order 173497, including financial restitutions which may or may not be incurred if Information Retrieval procedures beyond those incorporated in

Article 7 subsections 8, 10 and 32 are required to elicit information leading to permanent arrest - notification of which will he served with the time period of 5 working days as stipulated by law. In that instance the detainee will be debited without further notice through central banking procedures without prejudice until and unless at such a time when re-imbursement procedures may be instituted by you or third parties on completion of a re-imbursement form RB/CZ/907/X

. . . and more of the same, most of which is part of the audible wall paper while the chaos reigns. As the front door slams behind the captive relative peace returns, broken by MRS BUTTLE's anguished sobbing.

OFFICIAL

(proffering a pen and a thick book of pink receipts to Mrs Buttle) Sign here please.

MRS BUTTLE

(dazed. She signs weakly) What? where have you taken him?

OFFICIAL

(taking the book) thank you. (he hands her another book, this one of blue receipts) (indicating place to sign) Same again please. Just there. (checking first book of receipts) Press harder his time. Good.

MRS BUTTLE

(signing again) What is this all about?

OFFICIAL

(tearing out sheet from pink book) That's your receipt for your husband. (taking blue book from her) Thank you. And this is my receipt for your receipt. (he turns to leave along with troopers).

(Scene 19)

Later, this arrest, and Layton's efforts on the Buttles' behalf, take on more sinister tones, as Lowry's conversation with Lint indicates. Although Lint appears to be an alert, efficient employee, concerned about government security, in fact his rationale for Buttle's arrest indicates that his keen enthusiasm for protecting society is going to waste:

JACK

I'm afraid this whole case has become much more complicated since last we talked.

SAM

(exasperated) She's (Layton's) innocent, Jack --- she's done nothing wrong.

JACK

Tell that to the wives of the Security men she blew up this afternoon. Listen, we've also had a report just in from Central Services that Tuttle has wrecked an entire flat and sabotaged adjacent Central Services systems - as a matter of fact, in your block. I'd keep my eyes open if I were you, Sam. Bye.

SAM

(catching up with Jack) You don't really think Tuttle and the girl are in league?

JACK

I do. Goodbye. (steps into lift)

115 INT. LIFT EVENING 115

SAM

It could all be coincidental.

JACK

There are no coincidences, Sam. Everything's connected, all along the line. Cause and effect. That's the beauty of it. Our job is to trace the connections and reveal them. (whispers) This whole Buttle/ Tuttle confusion was obviously planned from the inside. (Scenes 114, 115)

Sam's earlier complaint about the technology in his apartment ("The electronics here are up the spout" (Scene 24)), could equally apply to the malfunctioning technocracy.

Tracing the connections of cause and effect can also describe the project of Cartesian rationalism, but the government in *Brazil* cannot rationally trace the connections of its own convoluted networks. Attempting to increase the level of refinement in its security system only generates another blizzard of records, making the security system less effective instead of more. Instead of creating a clearer sense of order for its citizens, the government contributes to the confusion, rendering undecidable the difference between the technocratic governing structure and the population it attempts to monitor and screen.

Traditionally, the motif of the binary that switches on or off, turns right or left, says yes or no represents the rational process at its most austere, as computers exemplify with their syllogistic, if/then conditions of 1's and 0's. In *Brazil* the mechanism that best represents the decision-making process of government departments also is organized by a simple binary. However, this executive gift, a silver cone that falls on the 'yes' or 'no' categories at random, separates the motivation (reason) from the result (arrest), making the decision-making process as inefficient as possible, as acts of chance. These yes/no gifts turn up in the restaurant (Scene 28), in Lowry's office (Scene 62), on the Porter's desk (Scene 80), and in the just-bombed shopping centre (Scene 107). Indeed Lowry's superior in Information Retrieval, Mr. Warren, is snapping out random decisions when Lowry first meets him:

> SAM steps out of the lift. The lift doors close. SAM looks up and down the corridor hearing nothing. Silence. Then he, and we, begin to hear a sound. It is a curious whirring murmuring tummeling sound, and it seems to be growing closer. Suddenly a scrum of PEOPLE swings into view around a corner at the far end of the rather long corridor. At the centre of the scrum is a TALL MAN with a magisterial expression and an air of eternal bustle. This is MR WARREN. He is surrounded by the EXPEDITERS who are competing for his attention with bits of paper and bits of sentences. MR WARREN is snapping out decisions. Satisfied EXPEDITERS drop out of the scrum at intervals, disappearing one at a time through one of the many doors which line both sides of the corridor. The scrum doesn't get any smaller because new EXPEDITERS dart out of other doors and join the milling MOB. The whole circus is coming by SAM at the rate of knots. The sound it makes breaks down into something like this.
>
> EXPEDITER 1
>
> (waving pager) Mr. Warren, this order . . .
>
> EXPEDITER 2
>
> (waving same) Mr. Warren . . .
>
> EXPEDITER 3
>
> (ditto) About this invoice . . . Victim's list . . .
>
> WARREN

(dealing on all sides) Yes . . . No . . . send that back . . . wrong department . . . of course . . . of course not . . . yes . . . no . . . maybe.

CUT to SAM watching this caravanserai with awe as it starts to pass him.

EXPEDITER 4

. . . about these requisitions . . .

EXPEDITER 5

Mr. Warren . . . EX/27 has 15 suspects still outstanding.

EXPEDITER 6

. . . a decision, Mr Warren . . .

WARREN

. . . cancel that . . . okay . . . put half as terrorists, the rest as victims . . yes . . . yes . . . no . . . definitely no . . . (Scene 60)

While Mr. Warren' s snap decisions imply that the system operates at peak efficiency, in fact the government's collective dream of social control, ostensibly in order to win the thirteen-year war against terrorism, has become just that. Instead of locating a rational technocracy in opposition to society, *Brazil* shows a technocracy whose aspirations of installing a grid of perfectly ordered space contributes, in fact, to what could be called a grid of imperfectly disordered space. Thus, Erlich's assessment, that the movie shows "the imposition of the mechanical and electronic upon the human and the use of that image as a metaphor for bureaucratization," does not go far enough to explain the dynamic of inefficiency that drives these government departments forward. Certainly, with terrorist bombs going off everywhere, the government could not implement a policy to reduce its attention to local security. Paradoxically, however, its attempts to increase the efficiency of its social management programs also overwhelm the system, leading to further security breaches. While Buttle, Lowry and Layton are all either unjustly killed or maimed by government security forces, terrorists continue to conduct random attacks against the civilian population. Helpmann's early comment, that the terrorists' thirteen year conflict was only "beginner's luck" (Scene 13), suggests that the government's dream of perfect order is spiraling out of control.

Stating that, in the world of *Brazil*, the government "dreams" of perfect order does not imply that another more grounded condition could be possible within this world. In fact, Lowry's own dreams contain many elements that overlap with his waking moments. After discovering that the woman he has dreamt about actually lives in the apartment above the Buttles', Lowry makes it his mission to find her and talk with her. He finally succeeds in talking to her while they escape from the government offices in her lorry:

84 EXT. CITY FREEWAY DAY 84

A high shot of the lorry, moving through the city among traffic.

85 INT. TRAVELLING LORRY DAY 85

JILL is preoccupied with driving. She is smoking a cigarette. SAM occasionally glances at her.

SAM

. . . This is amazing . . . for me . . . being here with you. I mean, in my dreams you . . .

JILL

I don't want to hear about your fucking dreams!

SAM

Oh. But . . . Look, I'm sorry I shouted at you.

JILL

(mainly to herself) Why are they all pigs at Information Retrieval?

SAM

I don't know. (realizing that this includes him) Hey, that's not a very nice thing to say.

JILL blows smoke in SAM's direction.

SAM

(waving the smoke away) You know, smoking's bad for you.

JILL

It's my fucking life. (Scenes 84, 85)

This blurring of the ontological distinction between dreaming and waking also takes place around images of nature.

Instead of Lowry's dreams presenting him with utopian images of nature that contrast with the cluttered spaces in which he lives, the blue skies and green hills of his dreams are interrupted by monolithic architectural structures that recall the government offices where he works. This scene appears in Lowry's first dream sequence:

> The ground far below him suddenly erupts as a massive, monolithic stone skyscraper bursts through the surface and soars upwards with a mighty rush.
>
> CUT to the GIRL in LONG SHOT. The monolith rises up into FRAME partially cutting her off from view.
>
> Before SAM can do anything, another stone skyscraper breaks through the ground and rushes upwards. Then another and another. There is nothing SAM can do. The GIRL is being cut off from him by these gigantic faceless structures. And then she is finally lost from view somewhere in the depths of this strange stone metropolis.

> SAM lies closer. The stone skyscrapers appear to be solid. No windows. No doors. Nothing whatsoever to interfere with their clean, harsh, rectilinear design. (Scene 23)

Brazil does not offer pithy morals regarding either the benefits or dangers of dreaming. Neither the oneiric nor the rational realms are cleanly aligned with technology or nature. Furthermore, neither technology nor nature is clearly aligned with the moral values of good or evil. Granted the environment *Brazil* depicts is dystopian. However, the movie resists singling out the traditional villains, since films with either nature or technology running amok are a common Hollywood staple. In the end, Derrida's application of Gödel's Undecidability Theorem applies here as well, "*tertium dater*; without synthesis." Critic Keith Booker advances a similar argument in his book, *Dystopian Literature: A Theory and Research Guide*. Focusing on Gilliam's *Brazil*, he writes:

> The contrast between the utopian dreams of Lowry's inner life and the dystopian reality of his outer life provides one of the major sources of energy in the film. Moreover, the film clearly suggests that fantasies like Lowry's are more than mere escapism. Granted, his fantasies are at least partially inspired by the regime's official propaganda, but at the same time they provide him with an independent point of view that allows him eventually to develop a critical perspective on the official world around him. Lowry's inner and outer lives are not entirely separate: much of the movement of the film involves a gradual combination of these two perspectives, resulting in a postmodern blurring of ontological boundaries that finally makes it impossible at certain points for the viewer to distinguish between 'dream' and 'reality'. (Booker 343)

This blurring of boundaries also makes it difficult to apply traditional readings to events that take place in Lowry's dreams. Although he appears in roles as both a lover and warrior in these sequences, neither leads to insights that help him work more efficiently during his waking moments. He does discover that the woman he loves in his dreams lives in the Buttles' apartment block, but he is unable to elude the government security and is arrested after they make love for the first time. His dreams of himself as warrior likewise do not lead him to any martial victories. In his dreams he confronts a crowd of "small, troll-like creatures" which according to Cowen, Gilliam "intended to be an intermingling of the beginning and ends of life" (Cowen). A giant samurai warrior emerges from this crowd, suited up with shiny armour and bearing a sword. Sam vanquishes them despite overwhelming odds, causing the samurai to self-destruct after he pins his foot to the pavement with his own sword. When Sam removes the warrior's mask he sees his own face, suggesting, as Cowen states, that the person he has been fighting has been himself, "lending itself to the Quixotic nature of Sam's quest." Cowen continues: "The samurai is a huge, monolithic, powerful machine, and is assumed to represent technology – and Sam (Lowry) finds his own participation in the machinations of this technologically based society to be a hindrance to his own self" (Cowen). One might think that Lowry's conquest over the samurai might carry symbolic value for the movie, but in fact it does not. When one of the security officers approaches Lowry to arrest him after the bomb detonates in the shopping mall, Lowry begins to see him as the warrior figure from his dreams. But although he 'gets the girl' of his dreams, his fight fantasy is not as successful. The officer throws Lowry into the back of a paddy wagon with other prisoners, and ultimately knocks him unconscious while he searches for Layton among the other detainees.

Gilliam's narrative, furthermore, does not offer closure for either side of this binary, as Foucault's theory of the Panopticon suggests it might. The ongoing dissipation of resources in this narrative -- resisting the resolution often offered by mythical, or meta-narrative, elements -- is reflected once again to a certain extent in Bataille's general economic theory. As Plotnitsky states

> Bataille's anti-phoenix vision of the physical universe . . . is both a metaphor and an example of a general economy, clearly provoked by modern physics. Developed and nuanced throughout Bataille's work, the anti-Hegelian structure of the process and hence of metaphor is important. (Plotnitsky R 301)

Like Bataille's anti-phoenix vision of the universe, the figures in *Brazil's* universe do not rise from the ashes to become better citizens or humanist subjects. Lowry's dreams of flight might traditionally suggest the possibility of his transforming, phoenix-like, and assuming a domestic role with Layton. The film's allusions to mazes, from the square patterns on the people mover, to the tangle of tubes and ducts, might suggest the importance of reason in helping Lowry emerge, Theseus-like, from the byzantine maze, having escaped the government minotaur. The closing reference to the garden might also suggest an Edenic antedote to the corrupted city. But this reference, like the others, does not lead to a traditional resolution, since Lowry only imagines this scene after he has been lobotomized by government security for undisclosed reasons.

Indeed, although Lowry occupies the central role in *Brazil*, this role is not that of the traditional heroic figure. He is content to remain coddled by his automated living space. When Mrs. Terrain asks Lowry whether, as a government official, he can't do something about the terrorist bombing which has disrupted their lunch, Lowry replies, "What? Now? It's my lunch hour" (Scene 28). When Mrs. Buttle inquires about her husband's death, the best Lowry can manage is, "I'm afraid there's been a mistake" (Scene 40). Even Sam's plan to save Jill is ineffectual. When he finally utilizes his bureaucratic skills to 'kill' Jill by doctoring up the paperwork (Scene 127), security forces still find her, and she is actually killed resisting arrest (Scene 132). As McCabe states: "[*Brazil* is] the tale of Sam Lowry, a man who knows his place in the system and conspires to remain beneath it – all the better to fuel his fantasies of beautifully distressed damsels and heroic winged saviours" (McCabe 119). By contrast, the character who might assume the hero's role is Archibald Tuttle, heating engineer, who is heroic because he "actually makes things work," as Gilliam states (in McCabe 126). But although he is wanted by government security for his role not in destroying property, but in fixing it, he only plays a minor role in the narrative, swooping in and out of two scenes on cables.

Kurtzmann's comment early in the movie sums up much of what follows: "It's been confusion from the word go" (Scene 34). Although *Brazil* portrays a dystopian society that's become saturated with technological structures, this alternative vision of the posthuman resists synthesizing the human into a clean and shining machine. Instead, the ending leaves the categories of machine and human suspended, without trying to supply an ending that resolves them. If indeed *Blade Runner* does close with this "appalling ending of driving off into the sunset" (Gilliam, in McCabe 124), *Brazil* ends with a sunset, a nature scene, that turns out to be only Lowry's hallucination of escape. The original outlaw that government security has been attempting to rein in, Archibald Tuttle, still goes free. But Sam Lowry, the bureaucrat whose crime involves wasting government time and materials, is captured and lobotomized by his old friend Jack Lint. As Booker states, "The film employs a number of postmodern techniques to produce a rich, complex, and ambiguous exploration of many of the issues typical of utopian and dystopian fictions" (Booker 342). These techniques keep the categories of machine and human, clean and dirty, in unresolved tension. Derrida: "*tertium dater*, without synthesis."

DRAWING CONCLUSIONS

This essay has briefly traced a genealogy of geometry, epistemology and technology. This tracing hopes to describe, not a linear geometric history, but, following Foucault, a layered one. This layered history attempts to portray some of the thresholds that epistemological issues crossed as mathematicians and philosophers took them up at different historical moments. Although some philosophers such as Plato and Descartes turned to geometry to demonstrate the soundness of purely rational principles, other philosophers such as Aristotle and Kant turned to geometry to demonstrate the soundness of rational principles combined with sensory experience. Each of these philosophers, until the nineteenth century, believed that Euclid's syllogistic method of reasoning in the *Elements* demonstrated that foundational epistemological principles were indeed possible.

Following the work of nineteenth century geometers such as Georg Riemann and Georg Cantor, this belief in epistemological foundations, through Euclid's syllogistic rational method, was placed in doubt by attempting to resolve the paradox of infinity that had been implicit in Euclid's theorem of parallel lines. Various attempts at re-establishing epistemological foundations were finally undermined when Kurt Gödel published his Undecidability Theorems. These theorems formally proved that formal proofs could not provide foundations for epistemology, because they will always generate paradoxical statements that cannot be proved. Jacques Derrida refers to Gödel's theorems in shaping his own approach to epistemology through deconstruction. Instead of finding that Gödel's model radically de-stabilized the search for meaning, Derrida finds that Gödel's theorem limits the amount of indeterminacy that can be admitted into a term's play of meanings. According to Derrida, deconstruction attempts to read terms such as "pharmacy," terms that appear to have one meaning, but in fact have two oscillating without resolution within.

This essay then attempted to apply this undecidability to a Foucauldian *episteme*, finding one in the term "posthuman" which is posited most notably by scholar Kathryn Hayles. Although the rhetoric of the posthuman celebrates the synthesis of body and machine into a third cyborgian condition, this essay considers other representations of the human/machine engagement, representations where this relation is not as harmonious as that touted by the 'posthumanists.' For this purpose the discussion turned to two late twentieth century films, Ridley Scott's *Blade Runner* and Terry Gilliam's *Brazil*, attempting to demonstrate how these recent narratives of the posthuman finally leave the machine and the human in tension, with neither absorbing the other.

It is possible that future research about the undecidable relation between machines and humans could attempt readings of narratives where the boundary between these two categories remains porous, wasting energy instead of providing the Hegelian synthesis dreamed of by the 'posthumanists.' Since, as Plotnitsky argues, Bataille's general economic theory offers a more indeterminate model than Derrida's (undecidable) deconstruction, it might also be possible to consider in greater detail the variety of meanings suspended under the umbrella of one sign. This approach would nudge the undecidability implicit in deconstruction over a few degrees, to the indeterminacy implicit in general economics. The increase in the range of readings that might be possible, of narratives featuring the machine/human interface, might also provide an antedote to the technological optimism expressed by purveyors of the posthuman *episteme*.

NOTES

[1] For example, consider the way structuralism deployed geometric models to organize narrative and social forms. According to Wilhelm Worringer (in *Abstraction and Empathy*), the history of the plastic arts records the shifts between "naturalist" and "non-naturalist" styles. When a culture feels harmonious with the universe (both the metaphysical and chthonic) it tends to produce art that represents the organic world. Its forms as nearly as possible attempt to create art within a three-dimensional space, encouraging the audience to look less at its condition as a creative work, and more as a window on a natural realm. Examples of these periods include the classical age of Greek art, the Italian Renaissance and the art of Western Europe near the close of the nineteenth century.

On the other hand, for Worringer, when a culture feels disharmonious, it produces art that reduces organic nature to "linear-geometric forms" that are crystalline, favoring "pure lines, forms and colours." By implication, a culture does not wish to reproduce artistic works that represent the very forces that are potentially dangerous or frightening. Non-natural art includes most primitive art, Egyptian monumental sculpture, Byzantine art, the abstract styles of the twentieth-century. As Joseph Frank states in "Spatial Form in Modern Literature," "Worringer argues that we have here a fundamental polarity between two distinct types of creation in the plastic arts. And, most important of all, neither can be set up as the norm to which the other must adhere" (Frank 71). With broad similarities, artistic production in the plastic arts alternates between these two fundamental poles.

Frank incorporates Worringer's formulation for the plastic arts into his own discussion of spatial form in literature. For Frank, Worringer's binary model is less interesting as a historical perspective on literature, than it is as a method for understanding how a "time-art" like literature attempts to become spatialized.

"In both artistic mediums, one naturally spatial and the other naturally temporal, the evolution of aesthetic form in the twentieth century has been absolutely identical" (Frank 74). Taking up Worringer's conception of the "will-to-form," Frank argues that in literature the impression of time slowing or stopping altogether, despite the onward flow of words, is created by shifting the narrative events out of a "realistic" three dimensional space. Action happens on planes. The suspension of history, or of the temporal element, is enhanced by cutting and splicing events in sharp juxtaposition with each other. Paradoxically, as Frank notes, when narrative is located in three-dimensional space it is least "spatial" and most temporal, or realistic.

Near the conclusion of his essay, Frank states, "In a purely formal sense . . . we have demonstrated the complete congruity of aesthetic form in modern art with the form of modern literature" (Frank 74). How congruous the interest of modern literature is in this particular conception of form will be taken up in greater detail below. But he illustrates his argument for the formalization of literature, by asserting that "[w]hat has occurred, at least so far as literature is concerned, may be described as the transformation of the historical imagination into myth -- an imagination for which historical time does not exist, and which sees the actions and events of a particular time only as the bodying forth of eternal prototypes" (Frank 76). After noting that the work of T. S. Eliot and James Joyce is "saturated with the myth of eternal repetition and . . . the abolition of time," he concludes: "And it is this timeless world of myth forming the common content of modern literature, that finds its appropriate aesthetic expression in spatial form" (Frank 76).

Frank's description derives from a structuralist framework. In a similar vein, Evans Lansing Smith's *Figuring Poesis: A Mythical Geometry of Postmodernism* mistakenly attempts to connect a geometric/myth-based reading that Frank would have admired within some matrix identified (and not defined) as postmodern. Smith:

> Myths (like the apocalypse, the goddess, alchemy, the maze, and the underworld) are the fundamental elements of literature; geometrical figures (like the circle, the square, and the triangle) are the fundamental elements of larger forms, like polygons. Taken together--which literature of postmodernism forces us to do--myths and geometrical figures form a universal grammar of the human imagination. As Schopenhauer put it, 'geometrical figures are the universal forms of all possible objects of experience and are applicable to them all *a priori*. (Smith 1)

Discussions that engage geometry to demonstrate the apparent stability and universality of forms in narrative (including formalisms beyond the mythic) commit a fundamental error in understanding the invention and contingency that characterize the geometric. Early twentieth-century geometers begin to understand geometry as a non-universal, "non"-*a priori* system. Frank (intentionally?) overlooks Worringer's own introduction of a third artistic practice into his model, a geometry that is both abstract and kinetic instead of crystalline (noted in Cache 84). This third tendency Worringer sees performing in the forms of Gothic art.

[2] A reading of geometry's relation with postmodernism should acknowledge Deleuze and Guattari's important contributions to this discussion. However, since the purpose of this essay is to apply the undecidability in deconstruction to the determinism that is implicit in Foucauldian historicism, Deleuze and Guattari's project of describing the multiplicity of energy flows in geometric terms must be bypassed in pursuit of this other goal.

[3] In "Of Grammatology as a Positive Science" Derrida re-writes a history of writing, beginning from the seventeenth-century, by taking note of Leibniz's plan to link numeric calculation with the development of a formal universal language. Calling these attempts at creating non-natural, formal languages "a debate exciting the passions of all European minds at the end of the seventeenth and all through the eighteenth centuries," Derrida locates the origins of this debate with the possibility of "sweeping away the '*theological*' prejudice" (his italics) (Derrida *Of Grammatology* 75). While sweeping away the theological relation to language (figured in the Biblical 'Tower of Babel' story), the possibility of constructing a formal language was nonetheless motivated by similar universalizing goals that had characterized natural language through its metaphysical associations. Derrida quotes Leibniz in this regard:

> I believe, however, that it would be possible to devise a further system to enable one to make up the primitive words and their symbols in such a language so that it could be learnt very quickly. Order is what is needed: all the thoughts which can come into the human mind must be arranged in an order like the natural order of the numbers. In a single day one can learn to name every one of the infinite series of numbers, and thus to write infinitely many different words in an unknown language. The same could be done for all the other words necessary to express all the other things which fall within the purview of the human mind. If this secret were discovered I am sure that the language would soon spread throughout the world. Many people would willingly spend five or six days in learning how to make themselves understood by the whole human race. (in Derrida *OG* 330 note 9)

While the development of a non-phonetic formal language would de-centre the history of language from its Judeo-Christian roots, for Leibniz the very rational principles that would permit the development of such a language pointed back to a theology, proving the existence of God. As Derrida quotes him further:

> Like Leibniz when he wishes to recall in a letter the link between the existence of God and the possibility of a universal script, I shall say here that "it is a proposition that [we] cannot demonstrate properly without explaining the foundations of the characteristic at length . . . But at present, suffice it to remark that the foundation of my characteristic is also the demonstration of the existence of god, for simple thoughts are the elements of the characteristic, and simple forms are the source of things. (Derrida *OG* 331 note 14)

Thus, Derrida states, Leibniz's blueprint for a universal, non-phonetic language based on numbers, where "reasoning and calculating are the same thing . . . does not interrupt logocentrism in any way" (Derrida *OG* 78). Instead, Leibniz's "universal logic" confirms the presence of "logos or the infinite understanding of God" (Derrida *OG* 78).

Like Derrida, Michel Serres discusses the relation of geometry to aspirations for creating a formal language, but does so by tracing the early roots of this history. Also like Derrida, Serres sees in geometers' recourse to a numerical language an attempt at stabilizing and universalizing communication through a quasi-religious mysticism. According to Serres, the geometric symbols themselves are already a kind of non-phonetic writing, particularly for the Pythagoreans and those who had come before. He states:

> When I draw a square and a diagonal in the sand, I do not in any way want to speak of this wavering, irregular, and inexact graph; I evoke by it the ideal form of the diagonal and of the square. I

> eliminate the empirical; I dematerialize reasoning. By doing this, I make a science possible, both for rigor and for truth, but also for the universal, for the Universal in itself. By doing this I eliminate that which hides form – cacography, interference, and noise – and I create the possibility of a science in the Universal for us. (Serres 69)

For Serres the elimination of noise that takes place when reasoning is abstracted from specific instances is best exemplified in the thinking processes of geometry. However, unlike Derrida, who uses geometry to model an anti-epistemology, Serres uses geometry to model an epistemological system for which pure communication is a possibility. Serres demonstrates his view by recounting the double-writing of geometry, with its semantics of words and numbers.

> Bearing with the Greek miracle, we have at our disposal two groups of texts. First, the mathematical corpus itself, as it exists in the *Elements* of Euclid, or elsewhere, treatises made up of fragments. On the other hand, doxography, the scattered histories in the manner of Diogenes, Laertius, Plutarch, or Athenaeus, several remarks of Aristotle, or the notes of commentators such as Proclus or Simplicius. It is an understatement to say that we are dealing here with two groups of texts; we are in fact dealing with two languages. Now, to ask the question of the Greek beginning of geometry is precisely to ask how one passed from one language to another, from one type of writing to another, from the language reputed to be natural and its alphabetic notation to the rigorous and systematic language of numbers, measures, axioms, and formal arguments. What we have left of all this history presents nothing but two languages as such, narratives or legends and proofs or figures, words

> and formulas. Thus it is as if we were confronted by two parallel lines which, as is well known, never meet. (Serres 125)

Whereas a deconstructive gesture might attempt to uncover the places where these two languages of words and numbers do not achieve synthesis in geometric theory (as Gödel demonstrates), Serres instead attempts to demonstrate the way these two systems merged, becoming a sealed and noise-free place of communication. He proposes three approaches to re-constructing the origins of geometry in Greek culture, the last of which will be considered here: 1.) geometry as pure communication that exorcises the "demon of noise from the exchange of messages"; 2.) Thales' abstracting the pyramid's shadow to determined its volume; 3.) geometry as "double writing . . . Using figures, schemas, and diagrams. Using letters, words, and sentences of the system, organized by their own semantics and syntax" (Serres 126). As Serres notes:

> Leibniz had already observed this double system of writing, consecrated by Descartes and by the Pythagoreans, a double system which represents itself and expresses itself one by the other . . . It also happens that the schema contains more information than several lines of writing, that these lines of writing lay out indefinitely what we draw from the schema, as from a well of a cornucopia. Ancient algebra writes, drawing out line by line what the figure of ancient geometry dictates to it, what that figure contains in one stroke. The process never stopped; we are still talking about the square or about the diagonal. We cannot even be certain that history is not precisely that. (Serres 127)

More than a double-writing of words and numbers, however, geometry's dual characteristic is more deeply rooted in the two cultures out of which it emerged.

> Now, many histories report that the Greeks crossed the sea to educate themselves in Egypt. Democritus says it; it is said of Thales; Plato writes in the *Timaeus*. There were even, as usual, two schools at odds over the question. One held the Greeks to be the teachers of geometry; the other, the Egyptian priests. This dispute caused them to lose sight of the essential: that the Egyptians wrote in ideograms and the Greeks used an alphabet. Communication between the two cultures can be thought of in terms of the relation between these two scriptive systems (*signaletiques*) . . . the historical relation of Greece to Egypt is thinkable in terms of the relation of an alphabet to a set of ideograms, and since geometry could not exist without writing, mathematics being written rather than spoken, this relation is brought back into geometry as an operation using a double system of writing. (Serres 128)

(The Egyptian connection to Greek geometry is also shown in the frontispiece to Euclid's *Elements* (1933 edition), which states: "EUCLID, fl. c. 300 B.C., lived in Egypt in the time of Ptolemy I. He is said to have been younger than Plato and older than Archimedes.") Writing does not carry the same anti-metaphysical, technological force for Serres as it does for Derrida. So Serres recounts this history as an attempt at fusing together the two distinct written languages: "We are therefore not concerned with merely linking two sets of texts; we must try to glue two languages back together again" (Serres 129). Serres then proceeds through the Pythagorean crisis brought about by the paradox of irrational numbers:

> Given a square whose side $AB = b$, whose diagonal $AC = a$.
>
> We wish to measure AC in terms of AB. If this is possible, it is because the two lengths are mutually commensurable. We can then write $AC/AB = a/b$. It is assumed that a/b is reduced to its simplest

form, so that the integers *a* and *b* are mutually prime. Now, by the Pythagorean theorem: $a^2 = 2b^2$. Therefore a^2 is even, therefore *a* is even.

If *a* is even, we may posit: $a = 2c^2$. Thus, *b* is an even number.

The situation is intolerable, the number *b* is at the same time even and odd, which, of course, is impossible. Therefore it is impossible to measure the diagonal in terms of the side. They are mutually incommensurable. (Serres 130)

They may be mutually incommensurable, but Serres' version of this history does not lead to Gödel's proofs of this same paradox, as it does for Derrida. Instead, he writes "the (hi)story which follows":

> Theodorus continues along the legendary path of Hippasus. He multiplies the proofs of irrationality. He goes up to the square root of 17 . . . Whereupon Theaetetus takes up the archaic Pythagoreanism again and gives a general theory which grounds, in a new reason, the facts of irrationality. Book X of the *Elements* can now be written. The crisis ends, mathematics recovers an order . . . (Serres 132)

Finally, according to Serres, the crisis and resolution in geometry is significant enough to effect the politics of ancient Greece. Following the recovery of order in mathematics,

> Royalty is founded. The Royal Weaver combines in an ordered web rational proportions and the irrationals; gone is the crisis of the reversal, gone is the technology of the dichotomy, founded on the square, on the iteration of the diagonal. Society, finally, is in order.

> This dialogue is fatally entitled, not *Geometry*, but the *Statesman*. (Serres 132)

As a result of the several deaths that were attributed to the crisis of irrational numbers for the mystical Pythagorean community, Serres concludes that "geometry begins in violence and in the sacred" (Serres 133). Serres' statement perhaps to a certain extent parallels Derrida's regarding a theological presence in the classical philosophies of geometry. However, Derrida's reading of the history of numbers attempts to pry open the closed narrative structures that Serres' account seems to seal off.

4 Trudeau:

> Let AB and CD be two straight line segments. We will say that a straight line segment XY is "common measure" of AB and CD if there are whole numbers m and n so that XY laid end-over-end m times is the same length as AB and XY laid end-over-end n times is the same length as CD. For example, if AB were a yard long and CD 10 inches, a segment XY of 2 inches would be a common measure with m=18 and n=5 for laying XY end-over-end eighteen times would produce a length of 36 inches, the same as AB, and laying XY end-over-end five times would produce a length of 10 inches, the same as CD. It was intuitively evident to the early Pythagoreans . . . that a common measure can be found for any pair of segments—thought of course it may be necessary to take XY quite small in order to measure both AB and CD exactly. Since AB/CD = (m•XY)/n•XY) = m/n, a "rational" number (that is a ration of whole numbers). What their intuition predicted was that the quotient of two lengths would always come out rational.

Now take a square with side equal to 1 and draw a diagonal. Applying the Theorem of Pythagoras to the right triangle FGH we get FH2 = FG2 + GH2 = $1^2 + 1^2 = 2$, so FH = the square root of 2. Therefore the quotient FH/FG of the two lengths FH and FG is equal to the square root of 2. If the early Pythagoreans had been correct that the quotient of two lengths is always rational, the square root of 2 would then be rational. But one of the later Pythagoreans. . . discovered, by an argument not based (primarily) on intuition, that the square root of 2 is not rational.

The proof runs as follows:

Any rational number can be reduced to lowest terms, that is, it can be expressed by whole numbers having no whole number factor (other than 1) in common; for example 360/75 =24/5 and 24 and 5 have no common factor. Therefore if the square root of 2 were rational it would be possible to express it as the square root of 2 = p/q where p and q are whole numbers with no common factor. Squaring both sides gives $2 = p^2/q^2$, and multiplying both sides by q^2 gives $2a^2 = p^2$. This means that p^2 is even, because it is twice another whole number. The Pythagoreans had preciously proven that only even numbers have even squares, so they knew that, since p^2 is even, p must be even also. Two consequences follow from this:

1.) p is twice some other whole number (this is what being "even" means) which we can call "r," so p = 2r.

2.) q is odd, for we said p and q have no common factor, and an even q would have a factor of 2 in common with p.

We will pursue (1). Substituting 2r for p in the equation $2q^2 = p^2$ (above), we get $2q^2 = (2r)^2$ or $2q^2 = 4r^2$. Dividing both sides by 2 gives $qs^2 = 2r^2$ so q^2, being twice a whole number, is even. As before this implies that q is even (only even numbers have even squares). But we just said in (2) that q is odd. As the hypothesis that the square root of 2 is rational has led to this contradiction, logic forces us to conclude that the square root of 2 is not a rational number.

Had the mathematical world decided to accept intuition as more reliable than logic the future of mathematics would have been quite different; but it did decide in favor of logic, and mathematicians even since have been trained to revere logic and mistrust intuition . . . To say mathematicians consider intuition unreliable, however, is not to say they have banished it from mathematics. On the contrary, the basic assumptions from which any branch of mathematics proceeds – the axioms – are accepted without proof, primarily because of intuitive appeal. And intuition plays a big role in the discovery of theorems as well, or mathematicians would be spending most of their time trying to prove false statements. It's just that intuitive evidence is not accepted as conclusive. (Trudeau 3,4)

5 Mathematics historian David Fowler offers information about the condition of original manuscripts:

> Our earliest glimpse of Euclidean material will be the most remarkable for a thousand years, six fragmentary *ostraca* containing text and a figure . . . found on Elephantine Island in 1906/07 and 1907/08 . . . These texts are early, though still more than 100 years after the death of Plato (they are dated on palaeographic grounds to the third quarter of the third century B.C.); advanced (they deal with the results found in the "Elements" [Book Thirteen] . . . on the

pentagon, hexagon, decagon, and icosahedron); and they do not follow the text of the Elements. . . . So they give evidence of someone in the third century BC located more than 500 miles south of Alexandria, working through this difficult material . . . this may be an attempt to understand the mathematics, and not a slavish copying . . . The next fragment that we have dates from 75 - 125 AD and again appears to be notes by someone trying to understand the material of the *Elements*. (Fowler 53)

6 As Copi states,

Alternative systems of 'geometry', non-Euclidean geometries, were subsequently developed, notably by Lobachevsky and Riemann. These were long regarded as ingenious fictions, mere mathematical playthings, in contrast with the Euclidean geometry which was 'true' of the real space about us. But subsequent physical and astronomical research along lines suggested by Einstein's theory of relativity has tended to show that – to the extent that the question is significant – 'real' or physical space is more probably non-Euclidean than Euclidean. (Copi 156)

7 Although many accounts describe the movements in mathematics and epistemology in the nineteenth century, Richard Trudeau, Douglas Hofstadter and David Ross recommend Ernest Nagel and James Newman's *Gödel's Proof* for its clear recounting of the stages leading up to the development of several non-Euclidean geometries, as well as to the publication of Gödel's Theorems that undermined some of the foundational aspirations of those non-Euclidean

geometries. I have thus followed and adapted their version of the issues through this section.

8 Although Gödel's theorems seemed to exert a decisive influence over projects for establishing epistemological foundations, the results that his theorems generate are themselves undecidable. For example, physicist Douglas Hofstadter, in *Gödel, Escher, Bach: An Eternal Golden Braid*, applies the theorems to epistemological issues relating humans to machines. After enumerating the features that he says are "essential abilities for intelligence," he states:

> Here one runs up against a seeming paradox. Computers by their very nature are the most inflexible, desireless, rule-following of beasts. Fast though they may be, they are nonetheless the epitome of unconsciousness. How, then, can intelligent behaviour be programmed? Isn't this the most blatant of contradictions in terms? . . . This is what Artificial Intelligence (AI) research is all about. And the strange flavor of AI work is that people try to put together long sets of rules in strict formalisms which tell inflexible machines how to be flexible. (Hofstadter 26)

Then in a concluding chapter, Hofstadter speculates about how the different levels of communication in a system, referred to in Gödel's undecidability theorems, can point the way toward an intelligence of machines. Through complex sets of strings that give directions to the machine under constantly changing conditions, machines feed back information that is then used on a higher level of logic (Hofstadter 641-680). One implication of Gödel's theorems, from this point of view, is that if machines can be programmed to perform in highly complex, flexible ways, perhaps human intelligence is also an extremely high order program that determines human possibilities.

Roger Penrose's reading of Gödel's theorems takes him in an opposite direction from Hofstadter. For him, Gödel's undecidability theorems demonstrate that the language of formal logic will never be sufficient to match the intelligence of humans. The human realm therefore will always remain superior to the machinic, in Penrose's view. After demonstrating how Gödel's theorem "dealt formalism a devastating blow" (Penrose 105), Penrose argues that the very capacity that Gödel needed to complete this task was that of "reflection," and of "intuition." "The type of 'seeing' that is involved in a reflection principle requires a mathematical insight that is not the result of the purely algorithmic operations that could be coded into some mathematical formal system" (Penrose 110). He concludes, in a manner at antipodes with Derridean deconstruction: "The notion of mathematical truth goes beyond the whole concept of formalism. There is something absolute and 'God-given' about mathematical truth. This is what mathematical Platonism is about" (Penrose 112). Some of the implications of these varied readings of Gödel's theorems will be explored in the final parts of this paper, in the narratives *Blade Runner* and *Brazil.*

Although Plotnitsky turns to Penrose for definitions of Gödel's theorem, as well as assessments regarding its significance, he does not mention Penrose's Platonic, and epistemological politics which counter the anti-epistemological aims of Derridean deconstruction, and especially Bohr's quantum mechanics and Bataille's general economics. For example, in an early chapter Plotnitsky writes:

> 'Undecidability' is one of Derrida's most important terms, introduced by analogy to Gödel's theorem. To borrow Roger Penrose's description, "What Gödel showed was that any . . . precise ('formal') mathematical system of axioms and rules of procedure whatever, provided that it is broad enough to contain descriptions of simple arithmetical propositions . . . and provided that it is free

> from contradiction, must contain some statements which are neither provable nor disprovable by means allowed within the system. The truth of such statements is thus 'undecidable' by the approved procedures. In fact, Gödel was able to show that the very statement of the consistency of the axiom system itself, when coded into the form of a suitable arithmetical proposition, must be one such 'undecidable' proposition'. (Plotnitsky *C* 10-11; quoting from Roger Penrose's *The Emperor's New Mind*, 102)

Indeed, the distance between Plotnitsky and Penrose's positions regarding epistemological certainty is demonstrated in Plotnitsky's essay, "Undecidability and Complementarity" (in *Complementarity: Anti-Epistemology after Bohr and Derrida*). Here Plotnitsky argues that Derrida's deconstruction may not be anti-Platonic enough, since it restricts the semantic field of play to a greater degree than is suggested by other anti-epistemological (non-)models presented by Bohr, Bataille and Nietzsche.

[9] Another approach to Gödel's theorem is proposed by mathematician Kenny Felder, reading the theorem through Douglas Hofstadter's *Gödel, Escher, Bach*.

"Gödel showed that for any formal axiomatic system, there is always a statement about natural numbers which is true, but which cannot be proven in the system. In other words, mathematics will always have a little fuzziness around the edges: it will never be the rigorous unshakable system that mathematicians dreamed of for millennia.

Like Gödel, Hofstadter begins with the assumption he wishes to disprove: that TNT is a complete foundational system that can express all the conditions of mathematics.

Steps of Hofstadter's proof

1.) Beginning with an assumption that is the opposite of what we hope to prove: Typographical number theory TNT expresses all mathematical statements. TNT consists of assigning symbols to simple mathematical functions. In TNT, symbols such as basic mathematical functions still in place: +, *, =, variables represented by a, a', a" . . . Logical symbols such as ~(not), V(or), E(there exists), A(all). Numbers are represented by two symbols (0, zero) and S (successor of). Therefore, 1 = S0, 2 = SS0, 3 = SSS0

In TNT, what we would normally call "statements" are written as "strings"; that is simple combinations of our allowed symbols. . .

For example ~Ea:a*a = SS0 which means "there does not exist any number 'a', such that 'a' times 'a' is two"; or, more concisely, "there is no square root of two."

As a formal system, TNT uses 5 axioms.

Because the rules of TNT are the same as those of numbers, we can say that the string S0+So=SS0 'proves' that 1+1 = 2.

Because TNT translates across from numbers, we can assume that the following statements are true: Any statement you can make about natural numbers can be written in a TNT string.

2.) If statement 1.) is true, its TNT string can be derived as a theorem from the axioms. If the statement is false, we can derive its converse from the axioms, by placing a ~ in front of it.

Where we want to end up, to show how Gödel's theorem works, is with a mathematical statement that is about itself.

That statement would be similar to this one, which we can call sentence G: "This statement is not a theorem of TNT." This is a paradox because if it is true it is false, & if false, true.

However, the statement is not about numbers themselves, but about itself as a statement. The challenge is to create a system of numbers that refers to itself. TNT makes statements about numbers, and Sentence G is a statement about another statement, namely itself.

- Begin by turning TNT into numbers, where each number & symbol in mathematics.

For example, TNT statement: ~Ea:a*a = SS0 becomes

223333262636262236262111123123666

If TNT is valid, then the Gödel number for TNT is valid as well.

Gödel number of the TNT string is the beginning of the discovery of numbers that describe numbers on the way to finding a number system that can paradoxically cancel out its own theoremhood.

But not all numbers are 'true': 123666111666, meaning 1 = 0 is not a valid theorem, whereas 123666112666111123666, meaning 1+0 =1, would be a valid theorem.

Three ways of stating a true fact:

1. Zero equals zero is true
2. The string 0=0 is a valid TNT theorem
3. The number 666111666 has the theoremhood property.

1. 666111666 has theoremhood is true
2. The TNT string for 666111666 has theoremhood" is a valid TNT theorem.
3. The Gödel number for the TNT string for '666111666 has theoremhood," has theoremhood.

Gödel's proof requires that we find a TNT string that talks about itself. We said at the time that it couldn't be one, because tnt strings are only about numbers. But now, we have suddenly found a way to srite tnt strings that claim theoremhood for other TNT strings

The Gödel number of a TNT string will always be bigger than the string, making it impossible to write out . . . since 10 equals 123123123123123123123123123123666.

Making a Gödel number manageable. . . arithmoquining TNT . . . a = S0

Gödel number . . . 262111123666

Arithmoquining . . . 262111123666=1

Arithmoquining gives us a generalized way to write one TNT statement about another statement.

T: a = S0

A: The Gödel number of Sentence T is 1.

T: The arithmoquine of ‘a’ is not a valid TNT theorem-number.

A: The arithmoquine of Sentence T is not a valid TNT theorem-number . . .

Sentence G: The arithmoquine of “The arithmoquine of ‘a’ is not a valid TNT theorem-number” is not a valid TNT theorem-number.

Do not have to write out ‘arithmoquine’ in TNT, it’s enough to know that we could if we wanted to.

TNT of itself not about numbers, just a game involving symbol strings. But symbols are interpreted, so that axiom 1 has meaning, and theorem 1 as well.

S0+S0 = SS0 . . . 1+1 = 2.

2.a) Any statement that we can make about natural numbers can be written in a TNT string.

2.b) TNT string can be derived as a theorem from the axioms.

1. Gödel’s theorem: end of the proof.
2. Sentence G: This statement is not a theorem of TNT.

If sentence G is false, then it is a theorem of TNT. Then we have a valid theorem which is false, and the whole system falls apart.

But sentence G is about a statement, & TNT makes statements about numbers. What's needed is a way to create numbers that talk about other numbers.

3. Change in notation . . . each symbol gets replaced with a 3 digit number . . . 0 is 666, S is 123, = is 111. The numbers are chosen arbitrarily, following only two rules: every number has three digits, and no two numbers are the same.

TNT statement: ~Ea:a*a = SS0

Gödelized: 223333262636262111123123666

123666112666111123666 means 1+0 = 1

123666111666 means 1 = 0

Definition: A Gödel number has theoremhood if it corresponds to a valid theorem of TNT — or, in other words, to a true statement about numbers.

Three ways to write mathematical facts:

1.) "Zero equals zero" is true

2.) The string 0=0 is a valid TNT theorem (that is, can be derived from axioms).

3.) The number 666111666 has the theoremhood property.

If a theorem is about numbers, a theorem about a theorem would also be about numbers, and also could be a valid theorem. . .

This gives us a way to write theorems that are about other mathematical statements, instead of just being about other numbers. This is a way to create TNT that talks about other TNT . . .

These sentences can all be written in TNT, because they are mathematical statements:

5 is not a theorem of TNT

10 is not a theorem of TNT

123666111666 is not a theorem of TNT.

A TNT string could not possibly be big enough to contain its owns Gödel number because it is always much bigger . . . The Gödel number for 10 is 123123123123123123123123123123666.

1.) The way to write a TNT string with a Gödel number that refers to itself is through "arithmoquining . . ." getting TNT sentences to talk about themselves because the Gödel number will always be too big to be included in its own string,

Arithmoquining does this by taking the Gödel number for a TNT string. You start with any sentence that has a free variable, which we'll call *a*. To arithmoquine the sentence, you take the Gödel number of the entire sentence, and replace all occurrences of the variable with that number.

For example, if we start with the sentence a = S0, we Gödelize this statement with 262111123666. To arithmoquine this statement we say 262111123666 =1, which is the same as saying a = S0 =1, which is also the same as saying 1=1+0 =1.

Just to keep things visually clear, we can write the two statements in pairs, where the first sentence has the variable, and the second arimoquines the first.

TNT statement: a = S0

Arithmoquined: The Gödel number of sentence TNT is 1.

We need to get an arithmoquined statement to talk about itself. So:

T: The arithmoquine of 'a' is not a valid TNT theorem-number.

A: The arithmoquine of Sentence T is not a valid TNT theorem-number.

In Sentence A, now is a statement about another arithmoquined statement.

So the sentence G, that he was looking for earlier could be written out as:

The arithmoquine of "The arithmoquine of 'a' is not a valid TNT theorem-number" not a valid TNT theorem-number. TNT claims that it can express all mathematical properties, so it should be able to express those two, so we should in principal be able to translate the above sentence into TNT; which is all it takes to undermine the system. Ironically, its very power of expression is what defeats TNT in the end. Yes, it so powerful it can express theorems that do not have theoremhood. (Kenny Felder's version of Gödel's Theorem).

> [10] This geometry is only metaphorical, it will be said. Certainly. But metaphor is never innocent. It orients research and fixes results. When the spatial model is hit upon, when it functions, critical reflection rests within it. In fact, and even if criticism does not admit this to be so. (Derrida *Force and Signification* 17)

In "White Mythology" (in *Margins of Philosophy*) Derrida outlines the relation of deconstruction to the use of metaphor in classical philosophy. In his reading of metaphor as defined by Aristotle, Derrida states that what is assumed for the transfer of meaning from metaphor to noun needs to be a conception of the world in which entities and their qualities are fixed by a metaphysics.

> Everything, in the theory of metaphor, that is coordinate to this system of distinctions or at least to its principle, seems to belong to the great immobile chain of Aristotelian ontology, with its theory of the analogy of Being, its logic, its epistemology, and more precisely its poetics and its rhetoric. (Derrida *MP* 236)

This "chain of Aristotelian ontology" naturalizes the transfer of meaning across terms, making the transfer appear to be the same rational syntax as the other philosophical language that surrounds it. "Thought stumbles upon metaphor, or metaphor falls to thought at the moment when meaning attempts to emerge from itself in order to be stated, enunciated, brought to the light of language. And yet . . . the theory of metaphor remains a theory of meaning and posits a certain original naturality of this figure" (Derrida *MP* 233). Derrida responds to the question of how a naturalized transfer of meaning is possible by considering the "systematic logic of metaphoric productions" (Derrida *MP* 265). The assumption of language in the use of metaphor in classical philosophy, he states, involves "the unity and continuity of meaning [that] dominates the play of syntax" (Derrida *MP* 266). Although Descartes employs metaphors such as the circle, or the sun, differently than Plato or Aristotle, Descartes nonetheless founds his rationalist philosophy on a metaphor of "natural light" that shines inside his mind. Descartes' belief in reason, and doubting the evidence of empiricism, claims only to accept the "'clear and distinct' ideas and what is mathematically self-evident" (Derrida *MP* 266). But at the heart of this process is Descartes' belief, through the metaphor of light transferring its value to reason, that God would be trustworthy, rational and would lead him to a foundational epistemology. The sunlight that God shines on him is the light that also shines on his interior:

> This return to itself – this interiorization – of the sun has marked not only Platonic, Aristotelian, Cartesian, and other kinds of discourse not only the science of logic as the circle of circles, but also, and by the same token, the man of metaphysics. The sensory sun, which rises in the East, becomes interiorized, in the evening of its journey, in the eye and the heart of the Westerner. He summarizes, assumes,

> and achieves the essence of man, 'illuminated by the true light'. (Derrida *MP* 268)

For Derrida, however, the function of metaphor in Western philosophy is "always an interruption of the course of ideas" (Derrida *MP* 270). Metaphor always interrupts the course of ideas in the Western tradition because it requires a circular reasoning, "the circular re-appropriation of literal, proper meaning." He continues:

> Henceforth the entire teleology of meaning, which constructs the philosophical concept of metaphor, coordinates metaphor with the manifestation of truth, with the production of truth as presence without veil, with the re-appropriation of a full language without syntax, with the vocation of a pure nomination . . . (Derrida *MP* 270)

One of deconstruction's aims, therefore, is to expose these "circular reappropriations" that take place through the metaphoric transfer of meaning. Instead of the metaphysical assumptions that stratify the world into an "immobile chain" through the work of metaphor in philosophical discourse, he states that "this supplement of a code which traverses its own field, endlessly displaces its closure, breaks its line, opens its circle, and no ontology will have been able to reduce it" (Derrida *MP* 271). When Derrida draws on Gödel's theorem, metaphorically, to show the operation of deconstruction, he does so in the context of "this displaced closure" that ensures the transfer of meanings circulates endlessly.

[11] Foucault does acknowledge the impossibility of knowing one's own archive in the *Archaeology of Knowledge*, suggesting his awareness of self-referential questions. He writes: "It is not possible for us to describe our own archive, since it is from within these rules that we speak, since it is that which gives to what we

can say" (Foucault *AK* 130). However, apart from general statements like this, he does not locate historicism within his own historicist theory, thus raising questions regarding the status of his own "voice" within this theory itself.

(*Blade Runner* Notes)

12 In *Storming the Reality Studio* Larry McCaffery describes a genealogy of machines portrayed in cyberpunk, as a parallel humanoid phylum: " . . . our primal urge to replicate our consciousness and physical beings (into images, words, machine replicants, computer symbols) is not leading us closer to the dream of immortality, but is creating merely a pathetic parody, a metaexistence or simulacra of our essences that is supplanting us, literally taking over our physical space and our roles with admirable proficiency. . ." (McCaffery 15, 16). Although this evolution is not a smooth ascent (see note 4) its tendency is toward closer similarity to the human as well as greater autonomy from the human.

13 McCaffery provides a "quick list of the cultural artifacts that helped shape cyberpunk ideology and aesthetics, along with books by the cyberpunks themselves . . ." (McCaffery 17). The list begins with Mary Shelley's *Frankenstein* (1818), "the first great myth of the industrial revolution reflecting the deeply schizophrenic attitude toward science so evident in postmodern culture . . ." The dread caused by the presence of technology is reflected in books as diverse as Dashiell Hammett's *Red Harvest* (1929): "the violence and surrealism of suburban life"; William Burroughs's *Naked Lunch* (1962): "a combination of comedy as black as clotted blood"; J.G.Ballard's *Crash*: "the secret satisfaction of watching machines fuck up" (McCaffery 25). On Ridley Scott's *Blade Runner* (1982): " . . . the movie shares with *Neuromancer* a focus on the moral and epistemological questions created by technology. No answers in sight" (McCaffery 25). The lack of

answers, as I hope to show, stems from the film's blurring of the technology/biology binary. Instead of a synthetic/authentic opposition, *Blade Runner* presents a range of life forms, crossing from technology into biology, but not caring that it does so. The distinction becomes irrelevant.

This study focuses on Scott's 1993 release of *Blade Runner: The Director's Cut* which includes several narrative elements that suggest that Deckard himself is also a replicant. Instead of closing with the "happy" ending of Deckard and Rachael's flight over green fields as the original studio release does, the Director's Cut closes earlier when Deckard enters the elevator with Rachael. This bleaker ending leaves the question of their fate unresolved since the departing couple is a staple happy ending in many Hollywood movies. Their status as replicants, however, implies that they are leaving not to "live happily ever after," but to begin their lives as fugitives.

[14] When Jameson speaks of the "death of the subject itself – the end of the autonomous bourgeois monad or ego or individual – and the accompanying stress, whether as some new moral ideal or as empirical description, on the decentering of that formerly centred subject or psyche" (Jameson *Postmodernism* 15), he is discussing the problem of expression for the post-modern subject, who no longer can rely on "some conception of [himself] as a monadlike container, within which things felt are then expressed by projection outward" (Jameson 15). In a sense the detective figure which circulates in *Blade Runner* struggles to maintain an old construction as a social group.

Donna Haraway's "Cyborg Manifesto" discusses the possibility of a new conception of subjectivity which rejects models of "organic wholes." The politics of a synthetic organism "skip[s] the step of original unity, of identification with nature in the Western sense. This is its illegitimate promise that might lead to subversion of its teleology as star wars" (Haraway, *Simians* 151). Alberto Moreiras, in "Hacking a Private Site in Cyberspace" criticizes Haraway's "Manifesto" for its disregard of the consequences of a "radically nonessentialist, postgender world in cyberspace" and its lack of provision for an alternative model which resolves problems of the old subjectivity (Morieras 193). One of the features of *Blade Runner's* ending addresses this problem of the "old subjectivity." By letting the hackneyed, time-worn literary figure of the down-and-out detective survive, escaping with Rachel, the replicant he has been hired to kill, the two-dimensionality of his character is subverted. The possibility opens, paradoxically, of his becoming as humane as the replicant through their time together.

[15] William Gibson, regarding the wash behind the ship of advancing technology:

> Once perfected, communication technologies rarely die out entirely; rather, they shrink to fit particular niches in the global info-structure. Crystal radios have been proposed as a means of conveying optimal seed-planting times to isolated agrarian tribes. The mimeograph, one of many recent dinosaurs of the urban office-place, still shines with undiminished *samisdat* potential in the century's backwaters, the Late Victorian answer to desktop publishing . . . . The eight-track tape format survives in the truckstops of the Deep South, as a medium for country music and spoken-word pornography . . . . The Street finds its own uses for things . . . . (Gibson 28, 29)

Not only do old technologies not die out entirely, as the Darwinian model would have it, they also do not simply "advance" in one inclining, left-to-right vector. If one considers the keypad of the computer, one can see how a relatively clumsy technology, that of the typewriter, is dragged and dropped onto the newer technology, when there is nothing self-evident about its being the interface that computer-users learn. We recall that typewriter keys were arranged in such a way, on early mechanical models, to prevent typists from typing too fast and causing the typewriter mechanisms to become jammed. One could consider transportation technologies in a similar way. Unfortunately, the scope of this essay does not allow for an exploration of the economic and social factors that influence the development of technology. For the purposes of this essay, however, I would like to inflect the phrase "technological evolution" with the multi-directionality which it presents to the real world, instead of the simple "advance" posited by technological optimists and pessimists alike.

[16] One could contrast Mark Dery's portrayal of "intimacy with machines" in nineteenth-century America's "passion for movement" on locomotives with the technological intimacy described by Bruce Sterling in the twentieth. Climbing inside the "steam technologies," which served as "relays between passion and mechanism," shows a system combining "mobility and incarceration" (Dery 18). Instead of climbing inside technology, in the twentieth century " . . . technology sticks to the skin, responds to the touch: the personal computer, the Sony Walkman, the portable telephone, the soft contact lens . . . the prosthetic limbs, implanted circuitry, cosmetic surgery, genetic alteration" (Sterling xiii). Instead of the human subject moving with the technology, it moves with us. Paul Virilio, as well, notes the "reduced mobility of the equipped invalid and the growing inertia of the over-equipped, 'valid' human population" ((Virilio "The Third Interval" 12). Virilio presents a more developed version of his ideas of technological speed and human inertia in *Speed and Politics*.) Twentieth-century technology offers the possibility of movement at tremendous speeds, but now the "incarceration" has become more complete, in the figure of the individual stationary at the computer terminal, surfing the net.

Blade Runner offers this version of non-kinetic movement when Deckard conducts the classic room search using a high-powered photograph scanner that he can interface with his voice. His body remains fixed throughout his walk around the room, and when he "finds" the evidence he is looking for, it is pictured in another photographic image. In a sense, the presence of sophisticated technology such as Deckard's photo scanner on the landscape encourages the human subject toward this sedentary form of movement. The machine dominates, fixes the subject under its light.

17 The difficulty in defining the technology/ human relation manifests itself in a term like "cyborg." The term was originally coined in an "Astronautics" article (September 1960) as a proposal for a "homeostatic system" which would cooperate with the body's own system of controls to allow freedom of movement in space exploration (in Gray 30, 31). Gray, Mentor and Figueroa-Sarriera's introduction to *The Cyborg Handbook* opts for a conservative, limited use of the term, because "in quantity and quality the relationship is new . . . 'cyborg' is as specific, general, powerful, and useless, a term as 'tool' or 'machine.' And it is just as important" (Gray 6). In the same *Handbook*, Hess dissents from Gray *et al's* conservative prescription in order to "carnivalize" the term with his phrase, "low-tech cyborgs." These include rock musicians, gardeners, TV watchers and "lucid dreamers" (in Gray 371-377). With too broad an application "cyborg" serves as a garbage bag for any human/machine connection, however tenuous.

18 Manuel DeLanda describes a hypothetical robot historian who traces the evolution of generations of technological devices:

> The robot historian of course would hardly be bothered by the fact that it was a human who put the first motor together: for the role of

humans would be seen as little more than that of industrious insects pollinating an independent species of machine-flowers that simply did not possess its own reproductive organs during a segment of its evolution. (DeLanda 3)

Haraway's depiction of the symbiotic union now possible between man and technology, "compounds of the organic, technical, mythic, textual and political. . . call us, interpellate us . . . into the matrices of techno-scientific maps . . ." (Haraway, "When Man" 42), Haraway may resist the independence of DeLanda's sentient robot, but since she uses the cyborg construct to develop a social program for human subjects, perhaps a machinic subjectivity with at least limited independence is also justified.

Bruce Mazlish's *The Fourth Discontinuity: The Co-evolution of Humans and Machines* locates the human and machine on a continuum, in order to better understand how the feelings of technological "distrust" and "alienation" by the human half of the binary can allow the human to retain "control" (Mazlish 5). Ideas of human control over a machinic other, as portrayed in cyberpunk fictions, are no longer plausible as models because both categories in post-modernism, not only the human "being" but also the machinic "being," are no longer stable enough entities to enable a "vital" human subject to maintain power over an "inert" machinic subject.

Brazil Notes

[19] The location of Gilliam's shoot for *Jabberwocky*, Port Talbot, South Wales, provided further inspiration for *Brazil* because its environment combines the pollution of industry with the beauty of nature. As McCabe states, "Port Talbot has a rather large steel works with a film of black soot that covers the sand. At night with sporadic fire spraying from its towers, it looks a little like the skyline of

Blade Runner. It is in other words, a perfect place from which Terry Gilliam could draw inspiration" (McCabe 111). Gilliam explains further, "Port Talbot is a steel town, where everything is covered with gray iron ore dust. Even the beach is completely littered with dust, it's just black. The sun was setting, and it was quite beautiful. The contrast was extraordinary. I had this image of a guy sitting there on this dingy beach with a portable radio, tuning in these strange Latin escapist songs like 'Brazil.' The music transported him somehow and made his world less gray" (in *The Battle of Brazil*).

[20] A genealogy of the term "clean," especially in its relation to the body, turns up in an early distinction between the dirty (linked to the corporal and, therefore, sinful world) and the clean (linked to a spiritual, sinless world). This distinction derives from the Christian tradition, in the first letter of Paul to the Corinthians (15.44). In this epistle the fleshly body, subject to sin, sickness, death, decay, is aligned with dirt. The spiritual body, the ideal one that is beyond sinfulness and death, is aligned with cleanliness.

This dichotomy remains in place, even when the spirit is no longer factored into the equation. Discourses about transcending the dirty flesh continue, in the "armoured machine" manifestos of the Futurists, the military theory discussed by Manuel DeLanda and Klaus Theweleit, and urban electrification as discussed by Angela Hoy. Likewise, theorist Deborah Lupton makes this scheme implicit in her discussion about the relation of computer technology to the human. According to her, one of the main utopian discourses around computer technology involves its potential to deliver humans from the body, leaving "the meat" behind in a realm that is pure mind (Lupton 100).

The re-configuration of "cleanliness" in these locations, I suggest, also connects back to the ideal of the body. Although the biological can be characterized by its fluidity, against which skin provides a discrete barrier, one could also argue that cleanliness finally permits the biological regime to survive. The body that lasts is the body that is clean, hardened against invasion from outside, against contamination or corruption in the forms of disease. The police finally arrest Sam for a long list of minor misdemeanors when he is at his least armored moment, after having finally made love to Jill in his mother's canopied bed. Likewise, Jill also becomes susceptible to capture after her role softens from that of the macho truck driver to that of Sam's lover. Although Lupton may argue that technology has the potential to deliver the user from the body, in *Brazil* the technological phylum initially appears to simply bring about the death of the body as the body becomes less armored against invasion. However, in the end the narrative does not permit such simple oppositional conditions of victory and defeat.

The term "clean" itself can only be cleaned up so much, its borders, as we can see, fluid and shifty, depending on its context. I would turn to Scott Bukatman's discussion of hardened and corrupted bodies that are represented in science fiction, one of the major genre's where technology is represented in narrative. According to Bukatman, the dirty body in fiction does not maintain its structure, leaking its interior fluids through wounds or bodily organs. Horror has this goopy, gory body as its staple. The audience turns away, fascinated. Or, the audience stares, transfixed in horror. The corrupted body, the body in agony, the body in decay, the body on the verge of dying. Revolting and gripping at the same time. This horrific body contrasts with the hero's hard body, impermeable to assault. Even a hero like Archibald Tuttle slides nicely into this category of "clean" perhaps because his hardness or immortality come from his ability to provide plumbing service, even as the government plumbers attempt to disrupt this service.

Dirty and clean as a bad/good binary come into play again when gender issues are factored in. Carol Pursell's essay, "Dirt and Disorder," engenders the history of the sewers of Paris and the attempts to bring this flow of "filth" under control:

> All over the world nature was conquered and disciplined, and even the cities, which at first glance appeared to be the very epitome of the artificial and constructed, were perceived to be feminine organisms, wastelands in some accounts, wilderness in others, and jungles in others. The need to bring cities under control, to make them safe for the masculine pursuits of profit, politics and power, required also that male control be exerted 'down there', in the deep recesses of the sewers where corruption and infection were rampant and all that was unlawful held sway. (Lupton 191)

While the crowds of *Blade Runner's* city mill about aimlessly amid the streets' squalor, the crowds in *Brazil's* city move with direction: they are engaged in the capitalist ritual of Christmas shopping, impervious to the effects of the terrorist bombings. The relative cleanliness of the city in *Brazil* serves the purpose of increasing the circulation of both the population as well as their capital.

Klaus Theweleit's history of the German Freikorps between the two world wars, entitled *male fantasies: women, floods, bodies, history*, constructs clean and dirty in an oppositional binary as well. In a section called "Bodies and Dirt" he writes:

> [Women were problematic for the Freikorps] because they turned solids into liquids when they cooked; and when they washed clothes and dishes, or took care of babies, they worked with, and in, things that were swampy, mushy. They stripped off the babies' wet pants and wiped the shit from their behinds. They cleared black

> muck out of stopped-up drains and cleaned toilets. They boiled the juice out of fruits and stored the extract. They wiped the floors and got their hands into liquid manure. And on and on. The average bourgeois male of the Wilhelmine era would have let himself be shot rather than touch those substances in any context that was reminiscent of "women's work." (Theweleit 409 - 410)

The social cleanliness to which the Freikorps aspired led to horrific results during the Nazi era which followed.

Theorists also discuss the flow of data across the computer screen in gendered terms that align with this binary of dirt and cleanliness. Lupton: "As with the female body, a site of intense desire and emotional security but also threatening engulfment, the inside of the computer body is dark and enigmatic, potentially leaky, harbouring danger and contamination, vulnerable to invasion" (Lupton 111). By contrast, she writes:

> . . . men find the concept of the cyborg attractive in its sheer invulnerability: the cyborg body is constituted of a hard endoskeleton covered by soft flesh, the inverse of the human body, in which the skin is a vulnerable and easily broken barrier between 'inside' and 'outside'. In these discourses the cyborg is therefore a predominantly masculine body, as contrasted with the seeping, moist bodies of women. (Lupton 101)

Bukatman makes a similar point through his reading of *Terminator II*: the fluid body of the more advanced synthetic is more the marvel of technology, but his ability to change from liquid into solid, makes him monstrous and therefore a target for Arnold Schwarzenneger's earlier model cyborg.

[21] Most commentators agree that this furore for experimentation resulted in a qualitative transformation in what modernism was about somewhere between 1910 and 1915 . . . Proust's *Swann's Way* (1913), Joyce's *Dubliners* (1914), Lawrence's *Sons and Lovers* (1913), Mann's *Death in Venice* (1914), Pound's 'Vorticist Manifesto' of 1914) . . . are some of the marker texts published at a time that also witnessed an extraordinary efflorescence in art (Matisse, Picasso, Brancusi, Duchamp, Braque, Klee, de Chirico, Kandinsky, many of whose works turned up in the famous Armory Show in New York, 1913 . . .) music (Stravinsky's *The rite of spring* opened to a riot in 1913 and was paralleled by the arrival of the atonal music of Schoenberg, Berg, Bartok, and others), to say nothing of the dramatic shift in linguistics (Saussure's structuralist theory of language . . . was conceived in 1911) and in physics, consequent upon Einstein's generalization of the theory of relativiity with its appeal to, and material justification of, non-Euclidean geometries. Equally significant . . . was the publication of F. W. Taylor's *The principles of scientific management* in 1911, two years before Henry Ford set in motion the first example of assembly-line production in Dearborn, Michigan. (Harvey 28)

[22] Dizard's essay, "Going Wild: The contested Terrain of Nature" illustrates the complexity of assigning clean values to nature and humanity:

> Thoreau was among the first in the United States to urge that we should respect nature by ending our efforts to tame and exploit her. This ideal, to be one with the natural order, is as powerful as it appears to be elusive. It is, it would seem, impossible for humans to

abstain from attempting to assert control over nature . . . Even the compromise of designating some areas parks or reserves has failed to protect them from human interference and degradation. This has led some to argue that all human activity should be banned in some areas in order that they remain "natural." But if humans must be banned, does that mean that we are declaring ourselves "unnatural"? To project purity and balance onto nature, and the opposite onto humanity, has appeal. But however appealing, there is no serious basis for thinking that undisturbed nature can either be recaptured in any genuine sense or that, if recaptured, it would produce anything like the harmony and balance that the protectionists dream of. To keep an area "natural," it seems, we would have to manage it like mad. (Jan E. Dizard 132)

[23] Although this optimistic view of the potential integration between biology and technology receives pressure today, arguably as a result of environmental groups, many theorists do in fact attempt to argue for technology as having benign effects on nature, and by extension, on humanity as well. For example, David Channell's *The Vital Machine* does not make use of the term "posthuman," as does Kathryn Hayles's text, but his interest in a "bionic" worldview that resolves the distinction between organisms and machines through reinterpreting language attempts a similarly optimistic project. The first two (of three) sections of Channell's text describes the way organic life (as he calls it) and machinic 'life' have cross-fertilized each other throughout history as "root metaphors." Channell believes Western society finds the proliferation of technology troubling. And he believes the source of this anxiety stems from the root metaphor with the greatest strength in Western societies at this time. This metaphor derives from Romantic

distinctions between an organic nature and a constructed technology. He argues, however, that despite the strength of this metaphor in late twentieth century Western culture, during the Romantic period itself, this distinction between nature and machine was not so clearly drawn. Prominent Romantic literary figures such as Schelling (secretary of the Academy of Sciences in Munich), Novalis (an amateur scientist), Coleridge (who lectured at the Royal Institution; wrote a book on biology) all believed in the beneficial effects of a certain kind of technological innovation. Wordsworth writes in a similar vein in his preface to *Lyrical Ballads*:

> The poet will be ready to follow the steps of the man of science, not only in those general indirect effects, but will be at his side, carrying sensation into the midst of the objects of the science itself. The remotest discoveries of the chemist, the botanist, or the mineralogist will be as proper objects of the poet's art as any upon which it can be employed. (in Channell 6)

The writers of the Romantic period objected to the "mechanical philosophies" advanced by Enlightenment writers René Descartes, Gottfried Leibniz, and David Hume, who argued that the mind functioned according to mechanical laws, as represented in the axioms of Euclidean geometry. Against the mechanical view of the mind as separating ideas into their component parts as a mechanic would before building a motor, Romantic writers preferred the model of the mind as a plant. Channell states: "The Romantics' protest on behalf of the organic was not directed at science and technology, but at the use of the machine as an image of thought and culture" (Channell 6). For Channell, therefore, Romantic writers did not object to science and technology on the whole. Instead they wanted to describe the functions of minds and culture in an organic instead of a technological metaphor.

Channell asserts that the discomfort manifested in late twentieth century Western culture regarding the blurring of distinctions between the organic and the technological derives from this linguistic level, from a confusion over the function of root metaphors of technology and organicity. Channell refers to Leo Marx's description of machine and garden as "cultural symbols," without addressing his and co-author Merritt Roe Smith's own version of "technological pessimism" (in *Does Technology Drive History? The Dilemma of Technological Determinism* [1996]). Instead, Channell takes a neo-Kantian approach, asserting that the symbols that society uses "transform our perceptions about the world" (Channell 8) and, by implication, transform society's relations with technology. These symbols can derive from "coexisting sets of beliefs and attitudes which result in two coexisting world views, each represented by its own cultural symbol . . ." (Channell 8).

Much of Channell's book therefore describes the ongoing negotiation between organic and mechanical worldviews throughout modernity. The tension between these perspectives causes one view, with its attendant sets of values, to dominate for a time before being suppressed by the other. In the mechanical worldview: "there is no conflict between actual machines and organic processes since both technology and life will be thought to be based on mechanical principles" (Channell 9). In the organicist view, on the other hand: "there is also no conflict between machines and organic processes since both will be thought to arise from some vital organization" (Channell 9). Instead of these opposing worldviews continuing to polarize interpretations of nature and technology, in a final section of the book Channell proposes a Hegelian synthesis, where a "bionic" perspective that is "consciously dualistic" in its understanding of the world would somehow balance both positions in one complex view.

Although Channell focuses on the interrelation between perspectives of the world that were technological and organic, it is also possible to extract a conception of nature, as does Raymond Williams, that progresses as a metaphor, independent for the most part of metaphors involving technology. To some degree, discussions about mergers with technology, such as those regarding the posthuman and the 'bionic', lead to unacknowledged mergers of 'nature' in an increasingly advanced 'technology'. Yet, as Williams shows, nature itself has its own history of cultural usage. He begins his history of the keyword "nature" with its root meaning, "to be born." The Latin root initially describes a particular quality or process but then develops into a noun independent of other referents. In the thirteenth century, nature tends to denote the essential quality and character of something; in the fourteenth century it refers to the inherent force that directs either the world or human beings; beginning in the seventeenth century, it begins to describe the material world itself.

The shift from nature as a "specific singular" to nature as an "abstract singular" occurs with the emergence of a single all-powerful God from "a god or gods" (Williams 222). Nature, as an abstraction, was linked to the primal force of the God who had created the whole material world. In medieval European usage, Nature functions as God's deputy, a tendency that conflicted with another popular conception of God as a monarch. According to Williams, both versions of nature demonstrated a sense of fatalism instead of self-determination. Nature here was capricious, usually exercising destructive effects on society.

Despite the strength of these ideas associated with Nature, Williams shows that these definitions all lack historical specificity. Shakespeare's *King Lear* in fact contains many senses of the term. Some of these definitions from *Lear* include "nature as the primitive condition before human society; the sense of an original innocence from which there has been a fall and a curse requiring redemption; the sense of the forms and molds of nature which can yet, paradoxically, be destroyed by the natural force of thunder; and the simple and persistent form of the goddess, Nature herself" (Williams 222). Thus, he states, "nature was at once innocent, unprovided, sure, unsure, fruitful, destructive, a pure force and tainted and cursed" (Williams 222). None of these senses of the term is resolved in the later seventeenth century, even though a stronger metaphor that surfaced was of nature as shifting from an absolute to a constitutional monarch, a shift that paralleled political events of the period in Britain.

In the eighteenth and nineteenth centuries then, nature is often personified as a "constitutional lawyer," the source of natural law that organized the realm of nature as well as the realm of society. Through this period, nature was seen "not as an inherent and shaping force but as an accumulation and classification of cases" (Williams 222). Williams quotes several lines from Alexander Pope to support this sense: "Nature and Nature's laws lay hid in night;/ God said, Let Newton be! and all was light!" (in Williams 222). The step from nature as law to conceptions of nature as reason was a small one. Enlightenment thought tended to draw on a personified idea of Nature to show how an "obsolete or corrupt society was in need of redemption and renewal" (Williams 223). Similarly, Romantic thought drew on conceptions of Nature that could cure a society that had become "artificial and mechanical" (Williams 223). Integrating Nature with legal practice through the Enlightenment and Romantic periods helped lay a foundation for arguments about the nature of an ideal society. Connecting versions of Nature with conceptions of primal force helped pave the way for arguments utilizing redemptive models.

According to Williams, Nature remains static in each of these manifestations, a sense which it retains today (Williams 223). Derived from the meanings above, nature today often refers to unspoiled natural places that have eluded human contact, although this definition may exist more as a concept than as a geographic reality. One final personification to which Williams refers attributes "ruthless competition" to a more powerful, active version of Nature. Once again Williams draws attention to the many meanings flourishing within this sense of the term. "The extraordinary accumulation of knowledge about actual evolutionary processes, and about the highly variable relations between organisms and their environments including other organisms, was again, astonishingly, generalized to a singular name. Nature was doing this and this to species" (Williams 224). This plurality of meanings in turn generates a range of uses to which Nature as a concept could be put, representing "aggression, property, parasitism, symbiosis, co-operation" (Williams 224). Each of these representations "have all been demonstrated, justified and projected into social ideas by selective statements of the form "Nature teaches. . .These various senses of Nature are usually suppressed and "cast on a singular Nature," even while evidence of variation "was being collected and used" (Williams 224).

[24] Thoreau challenges Emerson's view of a technology that integrates with nature. As Dizard states:

> For Thoreau, nature was exquisitely pure: truth prevailed and stood in stark contrast to the deceits and conceits of Concord. Nature was also, again in contrast to civilization, exquisitely balanced. (Dizard 112)

But as she also notes, Thoreau's view of nature as pure and distinct from human involvement was produced through his own reading of Walden Pond:

> . . . it is clear that Thoreau discovered something other than "pure nature." Though he permitted himself at least for expository purposes, the conceit that what he encountered was the natural

> order itself, it is abundantly clear that human beings had been altering nature long before he began building his simple cabin and recording his minute observations of nature's ways . . . Moreover, Thoreau brought with him a whole repertoire of assumptions and taxonomies with which to apprehend nature. The "wildness" that Thoreau engaged was, in other words, highly mediated, both by human presence and by the systematic knowledge that Thoreau's cultured had amassed about the natural world. (Dizard 111)

[25] The technological innovations of "monitors" and "screens" have also absorbed disciplinary inferences. For example, the *Oxford English Dictionary* defines "monitor" as both "Something that reminds or gives warning," and "A device for indicating or ascertaining the technical quality of a transmission without disturbing the transmission itself; esp. (also *monitor screen, tube*) a television screen for displaying the picture from a particular camera or that being transmitted." This convergence of meanings appears to lend credence to Bogard's theorizing the merger of surveillance technology and social discipline. My argument against Bogard, however, takes issue with the assumed operational efficiency of these technologies and the officers who operate them, since in a sense, even technology needs monitoring as well.

[26] For example, consider philosopher Michel de Certeau's approach to the panoptic aspirations of urban administrations:

> Today, whatever the avatars of this concept may have been, we have to acknowledge that if in discourse the city serves as a totalizing and almost mythical landmark for socioeconomic and political strategies, urban life increasingly permits the re-emergence

> of the element that the urbanistic project excluded. The language of power is in itself 'urbanizing,' but the city is left prey to contradictory movements that counterbalance and combine themselves outside the reach of panoptic power. The city becomes the dominant theme in political legends, but it is no longer a field of programmed and regulated operations. (de Certeau 95)

He continues in the same vein:

> . . . one can follow the swarming activity of these procedures that, far from being regulated or eliminated by panoptic administration, have reinforced themselves in a proliferating illegitimacy, developed and insinuated themselves into the networks of surveillance, and combined in accord with unreadable but stable tactics to the point of constituting everyday regulations and surreptitious creativities that are merely concealed by the frantic mechanisms and discourses of the observational organization. (de Certeau 96)

Many narratives do describe a panoptic environment where the panoptic mechanism operates with bloodless efficiency. Margaret Atwood's *The Handmaid's Tale* and George Orwell's *1984* describe this totalitarian structure from different points of view.

I would further contrast the model of technology as inefficient being presented here with one well-known representation of the "historico-metaphysical character" (Derrida *OG* 9) of cybernetics in Arthur Koestler's *The Ghost in the Machine.* Koestler draws out a metaphysical characteristic of technology in the assumption that technological systems are whole, and that complete metaphorical as well as technological transfers can be made from machines to human bodies. For example:

> The simplest illustration of feedback control is thermostatically regulated central heating. You set the thermostat in the living room at the desired temperature. If the temperature falls below it, the thermostat activates an electrical circuit, which in turn increases the rate of burning in the heating plant. If it gets too hot in the room, the opposite process takes place . . .
>
> The living organism is also controlled by a thermostatic device, which keeps its temperature at a stable level – with variations rarely exceeding one centigrade, more or less. The seat of the thermostat is the hypothalmus, a vital structure in the brain-stem. One of its functions is to maintain homeostasis – a steady body temperature, pulse rate, and chemical balance of body fluids . . .
>
> Self-regulating devices are found not only on the visceral level; they operate on every level of an organism's activities. A boy riding a bicycle, a tightrope-walker balancing himself with his bamboo stick, are perfect examples of kinetic homeostasis. (Koestler 98-99)

Many current mathematical and technological constructs such as fractal geometry, chaos theory, as well as conceptions of the "posthuman," return to the realm of numbers to both mystify and stabilize their totalizing epistemological structures. Narratives such as *Brazil*, however, invite a reappraisal of these structures, since in this context they operate, one could say, at maximum inefficiency. In this film, the mechanisms of posthuman surveillance function as chaotically as the population they are intended to regulate.

[27] Some of the complexity involved in a discussion of Bataille's general economy involves the degree to which his own distinction between general economics and restricted economics participates in a classical, restricted economic model. As Plotnitsky states in "The Maze of Taste: On Bataille, Derrida, and Kant":

> The crucial question that poses itself with regard to Bataille is whether the difference between restricted and general economy, even given the interaction between them, does not retain a kind of Kantian (and thus also inescapably Hegelian) trace of absolute difference – a trace not sufficiently erased or comprehended by Bataille. For a certain trace, given closure, will be unavoidable. This difference concerns not only an unconditional privilege or priority of expenditure over consumption. It could be pointed out in this context that the difference and asymmetry so inscribed in Bataille can be seen either as the difference between an economy of non-exchange – a non-economic economy – and an exchange economy, or as the difference between the economy of expenditure and the economy of consumption. (Plotnitsky *MT* 115)

The paradox of attempting to describe a theoretical model of expenditure is that this description also should reflect the same qualities of dissipation and waste as the theory being described. Too categorical a distinction between this and other economies invokes the same classical models that Bataille attempts to supplant. We do not have the time (or Bataille's 'energy') to pursue the degree to which he is able to establish a model that paradoxically would be considered successful to the degree this establishment remains in doubt.

[28] Compare Donna Haraway in Michael J. Shapiro's "The Politics of (Human) Nature in *Blade Runner*":

> By the late twentieth century in United States scientific culture, the boundary between human and animal is thoroughly breached. The last beachheads of uniqueness have been polluted if not turned into amusement parks – language, toll use, social behaviour, mental events, nothing really convincingly settles the separation of human and animal. (in Shapiro 71 – 72)

Like *Blade Runner*, the human and machine begin to share similarities in *Brazil*. Instead of a fascist technocracy that imposes a mechanistic will on its subjects, in *Brazil* the technocracy functions with no greater efficiency than the people, as though the abstract governing system had a will, only it was a will that lacked motivation.

WORKS CITED

Agamben, Giorgio. *Homo Sacer: Sovereign Power and Bare Life*. translated by Daniel Heller-Roazen. Stanford: Stanford UP, 1998.

Aristotle. *Metaphysics*. translated by Hugh Tredennick. Cambridge Mass.: Cambridge UP, 1935.

-----------. *Physics II*. translated by Hugh Tredennick.

-----------. *Posterior Analytics*. translated by Hugh Tredennick.

Asma, Stephen T. "Descartes meets *Blade Runner*." http://acweb.colum.edu/users/agunkel/film/asma.htm

Audi, Robert, editor. *The Cambridge Dictionary of Philosophy*. Cambridge: Cambridge UP, 1995.

Bataille, Georges. *The Accursed Share, Volume 1*. New York: Zone Books, 1988 (1967).

Baum, Robert J. *Philosophy and Mathematics: From Plato to the Present*. New York: Freeman, Cooper & Co. 1973.

Bogard, William. *The Simulation of Surveillance: Hypercontrol in Telematic Societies*. Cambridge: Cambridge UP, 1993.

Booker, Keith M. *Dystopian Literature: A Theory and Research Guide*. New York: Greenwood Press, 1984.

Bostock, David. "Mathematics, History of the Philosophy of." in *Oxford Companion to Philosophy*. http://www.xrefer.com/entry.jsp?xrefid=552742.

Boyne, Roy. *Foucault and Derrida: The Other Side of Reason*. London: Unwin Hyman Ltd., 1990.

Briggs, John. *Fractals: The Patterns of Chaos*. New York: Simon and Shuster, 1991.

Bukatman, Scott. *Terminal Identity: The Terminal Subject in Post-Modern Science Fiction*. Durham: Duke UP, 1993.

Cache, Bernard. *Earth Moves: The Furnishing of Territories*. translated by Anne Boyman. Cambridge, Mass.: The MIT Press, 1995.

Canguilhem, George. "The death of man, or exhaustion of the *cogito*?" in *The Cambridge Companion to Foucault*. edited by Gary Gutting. Cambridge: Cambridge UP, 1998.

Carroll, David. *Paraesthetics; Foucault, Lyotard, Derrida*. London: Methuen & Co. Ltd., 1987.

Carroll, Lewis. *The Annotated Alice: Alice's Adventures in Wonderland & Through the Looking Glass*. New York: Meridian Books, 1960.

Castagnetto, Susan *et al. History of Philosophy*. New York: HarperCollins, 1993.

Cavanaugh, Joanne P. "Humanities and the Arts." http://www.jhu.edu/~jhumag/0298web/math.html (13/11/02).

Channell, David. *The Vital Machine*. Oxford: Oxford UP, 1991.

Clark, Tim. "Deleuze and Structuralism: Toward a Geometry of Sufficient Reason." in *Deleuze and Philosophy; The Difference Engineer*. edited by Keith Ansell Pearson. London: Routledge, 1997.

Copi, Irving. *Symbolic Logic*. New York: Macmillan Publishing Co., Inc., 1973.

Cowen, David S. "Hypermedia *Brazil* FAQ." http://www.trond.com/brazil/b_faq08.html (08/11/02).

Crowe, Norman. *Nature and the Idea of a Man-Made World: An Investigation into the Evolutionary Roots of Form and Order in the Built Environment*. Cambridge, Mass.: MIT Press, 1997.

de Certeau, Michel. *The Practice of Everyday Life*. Berkley: U of California P, 1988.

DeLanda, Manuel. "Nonorganic Life." in *Incorporations*. edited by Jonathan Crary and Sanford Kwinter. New York: Urzone Inc., 1992.

-------------------- *War in the Age of Intelligent Machines*. New York: Urzone Inc., 1994.

Deleuze, Gilles. *Expressionism in Philosophy: Spinoza*. translated by Martin Joughin. New York: Zone Books, 1990.

--------------------. *Foucault*. Minneapolis: U of Minnesota P, 1995 (1986).

--------------------. *The Fold: Leibniz and the Baroque*. translated by Tom Conley. Minneapolis: U Minnesota P,1993.

--------------------. *The Logic of Sense*. translated by Mark Lester. New York: Columbia UP, 1990.

Deleuze, Gilles; Guattari, Felix. *A Thousand Plateaus; Capitalism and Schizophrenia*. translated by Brian Massumi. Minneapolis: U Minnesota P, 1993.

Derrida, Jacques. *Dissemination.* translated by Barbara Johnson, Chicago, U of Chicago P, 1981 (1972).

----------------------. *Edmund Husserl's Origin of Geometry: An Introduction by Jacques Derrida.* translated by John P. Leavey Jr. Lincoln: U of Nebraska P, 1989 (1962).

----------------------. "From Restricted to General Economy: A Hegelianism without Reserve." in *Bataille: A Critical Reader.* edited by Fred Botting and Scott Wilson. London: Basil Blackwell Press, 1998.

----------------------. *Limited, Inc.* edited by Gerald Graff. Chicago: Northwestern UP, 1988.

----------------------. *Margins of Philosophy.* translated by Alan Bass. Chicago: U of Chicago P, 1986.

----------------------. *Of Grammatology.* New York: Columbia UP, 1991.

Descartes, René. *Descartes: Philosophical Letters.* translated and edited by Anthony Kenny. Oxford: Clarendon Press, 1970.

---------------------. *Discourse on the Method of Rightly Conducting the Reason and Seeking Truth in the Sciences.* http://www.literature.org/authors/descartes-rene/reason-discourse/index.html. (10/11/02).

---------------------. *Meditation II.* translated by John Veitch. 1901. http://philos.wright.edu/DesCartes/Meditation2.html (10/11/02).

---------------------. *The Philosophical Works of Descartes.* translated and edited by Elizabeth S. Haldane and G.R.T. Ross. Cambridge: Cambridge UP, 1970.

Dick, Philip K. *Do Androids Dream of Electric Sheep?* New York: Ballantine Books, 1968.

Dizard, Jan E. "Going Wild: The Contested Terrain of Nature." in *In the Nature of Things: Language, Politics, and the Environment.* edited by Jane Bennett and William Chaloupka. Minneapolis: U of Minnesota P, 1993.

During, Simon. *Foucault and Literature: Towards a Genealogy of Writing.* London: Routledge, 1992.

Erlich, R.D. "Study Guide for *Brazil.*" http://www.users.muohio.edu/erlichrd/vms_site/brazil.htm

Euclid. *The Elements of Euclid.* London: J.M. Dent & Sons, 1933.

Felder, Kenny. *Kenny's Overview of Hofstadter's Explanation of Godel's Theorem.* http://www2.ncsu.edu/unity/lockers/user/f/felder/public/kenny/papers/godel.html

Focillon, Henri. *The Life of Forms in Art.* New York: Zone Books, 1989 (1934).

Foucault, Michel. "A Preface to Transgression." in *Bataille: A Critical Reader.* edited by Fred Botting. London: Blackwell Publishers, 1997.

---------------------. *Discipline and Punish: The Birth of the Prison.* translated by Alan Sheridan. New York: Vintage Books, 1979.

---------------------. *Madness and Civilization: A History of Insanity in an Age of Reason.* translated by Richard Howard. New York: Vintage Books, 1988.

---------------------. "Nietzsche, Genealogy, History." in *The Foucault Reader.* edited by Paul Rabinow. New York: Random House, 1984.

---------------------. *Archaeology of Knowledge & The Discourse on Language.* translated by Alan Sheridan. New York: Pantheon Books, 1972.

---------------------. *The Order of Things: An Archaeology of the Human Sciences.* New York: Vintage Books, 1970.

---------------------. "What is Enlightenment?" translated by Mathew Henson. http://eserver.org/philosophy/foucault/what-is-enlightenment.html

Fowler, D. H. *The Mathematics of Plato's Academy : A New Reconstruction.* Oxford: Oxford UP, 1987.

Frank, Joseph. "Spatial Form in Modern Literature," in *Criticism: The Foundations of Modern Literary Judgment*, ed. Mark Schorer, Josephine Miles, Gordon McKenzie. New York: Harcourt, Brace, & Co., 1958.

Frege, Gottlob. *The Basic Laws of Arithmetic: Exposition of the System.* translated by Montgomery Furth. Los Angeles: U of California P, 1964 (1893).

Garber, Daniel. "Leibniz: physics and philosophy." in *The Cambridge Companion to Leibniz.* edited by Nicholas Jolley. Cambridge: Cambridge UP, 1995.

Gibson, William. "Academy Leader." in *Cyberspace: First Steps.* edited by Michael Benedikt. Cambridge: MIT Press, 1995.

Gilliam, Terry. *Brazil.* Universal Pictures, 1985. http://www.trond.com/brazil/brazil_script.htm

Gleick, James. *Chaos: Making a New Science.* New York: Viking, 1987.

Godel. Kurt. *On formally undecidable propositions of Principia Mathematica and related systems*. Translated by B. Meltzer. New York: Basic Books, 1962.

Grattan-Guinness, I. "Euclidean Geometry." in *The Cambridge Dictionary of Philosophy*. Cambridge: Cambridge UP, 1995.

Gray, Chris Hables; Mentor, Steven; Figuero-Sarrieroa, Heidi J. "Cyborgology: Constructing the Knowledge of Cybernetic Organisms." in *The Cyborg Handbook*. edited by Chris Hables Gray *et al.* New York: Routledge, 1995.

Gutting, Gary. "Michel Foucault: A User's Manual." in *The Cambridge Companion to Foucault*. edited by Gary Gutting. Cambridge: Cambridge UP, 1998.

Gwaltney, Marilyn. "Androids as a Device for Reflection on Personhood." in *Retrofitting Blade Runner: Issues in Ridley Scott's Blade Runner and Philip K. Dick's Do Androids Dream of Electric Sheep?* edited by Judith B. Kerman. Bowling Green: Bowling Green State University Popular Press, 1991.

Hallyn, Fernand. *The Poetic Structure of the World: Copernicus and Kepler*. New York: Zone Books, 1990.

Hamacher, Werner. *Pleroma – Reading in Hegel*. translated by Nicholas Walker and Simon Jarvis. Stanford: Stanford UP, 1998.

Haraway, Donna. "A Cyborg Manifesto: Science, Technology and Socialist Feminism in the Late Twentieth Century." in *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge, 1991.

----------------------. "Cyborgs and Symbionts: Living Together in the New World Order." in *The Cyborg Handbook*.

----------------------. "When Man (TM) is on the Menu." in *Incorporations*.

Harvey, David. *The Condition of Postmodernity*. London: Blackwell, 1997.

Hayles, N. Katherine. *How we became posthuman : virtual bodies in cybernetics, literature, and informatics*. Chicago: U of Chicago P, 1999.

Heath, Sir Thomas. *A History of Greek Mathematics, Volume I.* London: Dover, 1981.

Heldreth, Leonard. G. "The Cutting Edges of *Blade Runner*." in *Retrofitting* Blade Runner.

Hilbert, David. *The Foundations of Geometry*. translated by E. J. Townsend. Chicago: Open Court Pub. Co., 1910.

Hofstadter, Douglas. *Godel, Escher, Bach: An Eternal Golden Braid*. New York: Vintage Books, 1989.

Hoy, Suellen. *Chasing Dirt: The American Pursuit of Cleanliness.* New York: Oxford UP, 1995.

Husserl, Edmund. "The Origin of Geometry." in *Edmund Husserl's Origin of Geometry: An Introduction.* translated by John P. Leavey Jr. Lincoln: U of Nebraska P, 1989 (1939).

------------------------. *Formal and Transcendental Logic*, The Hague: Nijhoff, 1969.

Hutchings, Kimberley. *Kant, Critique and Politics.* London: Routledge, 1996.

Jameson, Fredric. *Postmodernism or, The Cultural Logic of Late Capitalism.* Durham, Duke UP, 1995.

Kaplan, Craig. "The Halting Problem." http://www.cs.washington.edu/homes/csk/halt.html. (10/11/02).

Karatani, Kojin. *Architecture as Metaphor: Language, Number, Money.* translated by Sabu Kohso. Cambridge, Mass., MIT Press, 1995.

Kant, Immanuel. *Critique of Pure Reason.* translated by Norman Kemp Smith. http://www.arts.cuhk.edu.hk/Philosophy/Kant/cpr/cpr-open.html. (10/11/02).

---------------------. *Prolegomena to Any Future Metaphysics.* translated by Paul Carus http://eserver.org/philosophy/kant-prolegomena.txt. (10/11/02).

Kelly, Kevin. *Out of Control: The New Biology of Machines.* New York: Perseus Printing, 1995.

Kline, Morris. *Mathematics in Western Culture.* Oxford: Oxford UP, 1964.

-----------------. *Mathematics: The Loss of Certainty.* Oxford: Oxford UP, 1980.

Kørner, Stephen. *The Philosophy of Mathematics: An Introductory Essay.* New York: Dover Press, 1968.

Koestler, Arthur. *The Ghost in the Machine.* London: Hutchison and Co., 1967.

Kroker, Arthur. *Technology & the Canadian Mind.* Montreal: New World Perspectives, 1996.

Leibniz, Wilhelm. *Discourse on Metaphysics.* http://www.geneseo.edu/~easton/humanities/Leibniz.html. (10/11/02).

-----------------------. *Monadology.* translated by Robert Latta. Oxford: Oxford UP, 1925.

-----------------------. *Philosophical Writings.* translated by Mary Morris and G. H. R. Parkinson. London: J. M. Dent & Sons, 1990.

Lucas, J.R. *A Simple Exposition of Godel's Theorem.* http://users.ox.ac.uk/~jrlucas/simplex.html

Lupton, Deborah. *Medicine as Culture: Illness, Disease and the Body in Western Society.* New York: Sage Publications, 1994.

Lyotard, Jean-Francois. *The Postmodern Explained.* translated by Virginia Spate *et al.* Minneapolis: U of Minnesota P, 1993.

Matheson, Karl and Kirchhoff Evan. "Chaos and Literature." in *Philosophy and Literature.* Nr. 1. S. 28-45, 1997.

Mazlish, Bruce. *The Fourth Discontinuuity: The Co-evolution of Humans and Machines.* New Haven: Yale UP, 1993.

Marx, Leo. *The Machine in the Garden: Technology and the Pastoral Ideal in America.* Oxford: Oxford UP, 1967.

Marx, Leo; Smith, Merritt Roe, editors. *Does Technology Drive History? The Dilemma of Technological Determinism.* Cambridge, Mass.: MIT Press, 1996.

McCabe, Terry. *Dark knights and Holy Fools: The Art and Films of Terry Gilliam.* New York: Universe Publishing, 1999.

McCaffery, Larry. *Storming the Reality Studio.* London: Verso, 1991.

McEwen, Indra Kagis. *Socrates' Ancestor: An Essay on Architectural Beginnings.* Cambridge, Mass.: The MIT Press, 1994.

McFarlane, Thomas J. *Kant and Mathematical Knowledge.* http://www.integralscience.org/sacredscience/SS_kant.html

Megill, Allan. *Prophets of Extremity: Nietzsche, Heidegger, Foucault, Derrida.* Berkeley: U of California P, 1990.

Miller, Paul Allen. *The Classical Roots of Poststructuralism: Lacan, Derrida, and Foucault.* http://ehostvgw5.epnet.com/ehost.asp?key=204.179.122.140_98000_-517237051&site- ehost&return=y

Montaigne, Michel de. *Complete Works: Essays, Travel Journals, Letters.* Stanford: Stanford UP, 1958.

Moreiras, Alberta. "Hacking a Private Site in Cyberspace." in *Rethinking Technologies.* Minneapolis: U of Minneapolis P, 1993.

Nagel, Ernest and Newman, James R. *Godel's Proof.* New York: New York UP, 1958.

Norris, Christopher. "'What is Enlightenment?': Kant According to Foucault." in *The Cambridge Companion to Foucault.*

Nye, David E. *American Technological Sublime.* Cambridge, Mass.: MIT Press, 1996.

O'Connor, J. J. and Robertson, E. F. *Euclid of Alexandria.* http://www-groups.dcs.st-and.ac.uk:80/~history/Mathematicians/Euclid.html

Osler, Margaret. *Divine will and the mechanical philosophy: Gassendi and Descartes on contingency and necessity in the created world.* Cambridge: Cambridge UP, 1994.

Oxford Companion to Philosophy. "Formal Language." http://www.xrefer.com/entry/552094

Palmquist, Stephen. *Kant on Euclid: Geometry in Perspective.* http://www.hkbu.edu.hk/~ppp/srp/arts/KEGP.html

Panofsky, Erwin. *Perspective as Symbolic Form.* translated by Christopher S. Wood. New York: Zone Books, 1991 (1927).

Peckhaus, Volker. *19th-Century Logic Between Philosophy and Mathematics.* http://www.phil.uni-erlangen.de/~p1phil/personen/peckhaus/texte/logic_phil_math.html

Penrose, Roger. *Shadows of the Mind.* Oxford: Oxford UP, 1994.

---------------------. *The Emperor's New Clothes.* Oxford: Oxford UP, 1989.

Piel, Jean. "Bataille and the World: From 'The Notion of Expenditure' to *The Accursed Share.*" in *On Bataille: Critical Essays.* edited by Leslie Anne Boldt-Irons. New York: SUNY Press, 1995.

Plato. *Phaedrus.* translated by Harold North Fowler. Cambridge, Mass.: Harvard UP, 1914 – 1937 (series).

-------. *Timaeus.* translated by Harold North Fowler. Cambridge, Mass.: Harvard UP, 1914 – 1937 (series).

-------. *Giorgias.* translated by Harold North Fowler. Cambridge, Mass.: Harvard UP, 1914 – 1937 (series).

Plotnitsky, Arkady. *Complementarity: Anti-Epistemology After Bohr and Derrida.* Durham: Duke UP, 1994.

------------------------. *Reconfigurations: Critical theory and General Economy.* Gainesville: UP of Florida, 1993.

------------------------. "The Maze of Taste: On Bataille, Derrida, and Kant." in *On Bataille: Critical Essays.* edited by Leslie Anne Boldt-Irons. New York: SUNY Press, 1995.

Posy, Carl J. "Mathematical Philosophy." in *The Cambridge Dictionary of Philosophy.* edited by Robert Audi. Cambridge: Cambridge UP, 1995.

Prigogene, Ilya and Stengers, Isabelle. *Order out of Chaos.* New York: Bantam, 1984.

Rabinbach, Anson. *The Human Motor: Energy, Fatigue, and the Origins of Modernity.* Berkeley: U of California P, 1992.

Rajchman, John. *Constructions.* Cambridge, Mass., The MIT Press, 1997.

Raymont, Paul. "Leibniz's Distinction Between Natural and Artificial Machines." *Paideia.* edited by Stephen Dawson. http://www.bu.edu/wcp/Papers/Mode/ModeRaym.htm. 07/11/02.

Reichenbach, Hans. *The Philosophy of Space and Time.* translated by Maria Reichenbach and John Freund. New York: Dover Publications Inc., 1958.

Romanyshyn. Robert D. *Technology as Symptom and Dream.* London: Routledge, 1992.

Ross, David S. *Foundation Study Guide: Philosophy of Mathematics.* http://ios.org/pubs/F_phimat.asp

------------------. *Kantian Quantum Mechanics.* http://www.friesian.com/undeed-1.htm

-------------------. *Ontological Undecidability.* http://www.friesian.com/undeed-1.htm

Ross, G. M. "The Implications of Leibniz's Philosophy for Education in a Technological World." *Learning and Teaching Support Network: Philosophical and Religious Studies Centre.* http://www.prs-ltsn.leeds.ac.uk/philosophy/articles/historical/leibedfull.html#r21

Rosser, J. B. *Logic for Mathematicians.* New York: Chelsea Publishing Co., 1978.

Russell, Bertrand. *An Essay on the Foundations of Geometry.* New York: Routledge, 1996 (1897).

Said, Edward. *The World, The Text and the Critic.* Cambridge MA: Harvard UP, 1984.

Schoules, Peter A. *Descartes and the Possibility of Science.* New York: Cornell UP, 2001.

Scott, Ridley. *Blade Runner.* Burbank: Warner Brothers, 1982.

-----------------. *Blade Runner: The Director's Cut.* Burbank: Warner Brothers, 1993.

Sepper, Dennis L. *Descartes's Imagination: Proportion, Images, and the Activity of Thinking.* Berkeley: U of California P, 1996.

Serres, Michel. *Hermes: Literature, Science, Philosophy.* edited by Josue V. Harari and David F. Bell. Baltimore: The Johns Hopkins UP, 1992.

Schoules, Peter A. *Descartes and the Possibility of Science.* New York: Cornell UP, 2001.

Shapiro, Michael J. "'Manning' the Frontiers: The Politics of (Human) Nature in *Blade Runner.*" in *In the Nature of Things: Language, Politics, and the Environment.*

Shapiro, Stewart. *Philosophy of Mathematics: Structure and Ontology.* Oxford: Oxford UP, 1997.

----------------------. *Problems of the Philosophy of Mathematics.* http://www.xrefer.com/entry/552743

Smith, Evans Lansing. *Figuring Poesis: A Mythical Geometry of Postmodernism.* New York: Peter Lang Publishing, 1997.

Smith, Merritt Roe. *Does Technology Drive History? The Dilemma of Technological Determinism.* Cambridge: MIT Press, 1994.

Spivak, Gayatri. "Translator's Preface." in *Of Grammatology.* by Jacques Derrida. Baltimore: The Johns Hopkins Press, 1997.

Theweleit, Klaus. *Male Fantasies, Volume I: Women, Floods, Bodies, History.* translated by Chris Turner. Minneapolis: Minnesota UP, 1987.

Trudeau, Richard. J. *The Non-Euclidean Revolution.* Boston: Birkhauser, 1987.

Visker, Rudy. *Michel Foucault: Genealogy as Critique.* translated by Chris Turner. London: Verso, 1995.

Watson, Stephen. "'Between Tradition and Oblivion': Foucault, the Complications of Form, the Literatures of Reason, and the Esthetics of Existence." in *The Cambridge Companion to Foucault.*

Wiener, Norbert. *Cybernetics or Control and Communication in the Animal and the Machine*. Cambridge: MIT Press, 1961.

Worringer, Wilhelm *Abstraction and Empathy: A Contribution to a Psychology of Style*. translated by Michael Bullock. New York: Ivan R. Dee, 1997 (1908).