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THE POLICE IN DIFFERENT VOICES: ISAAC NEWTON AND HIS PROGRAMME OF PURIFICATION

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By

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THE POLICE IN DIFFERENT VOICES: ISAAC NEWTON AND HIS PROGRAMME OF PURIFICATION

A Dissertation APPROVED FOR THE
DEPARTMENT OF ENGLISH

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IN MEMORIUM

Michael C. Flanigan

April 5, 1936- May 15 2002

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ABSTRACT

This work positions Isaac Newton's three areas of inquiry—Natural Philosophy, alchemy, and theology—as three inter-locked "literacies," each with its own corrupt text and purifying method of reading. Newton's natural philosophical literacy, a method of purifying reading the book of nature, is driven by coded concepts, including crypticity, Oneness, and purification, drawn from Newton's heretical Christianity. Those concepts also drive his interactions with the Royal Society and his contemporary Enlightenment scientists. Newton's alchemical literacy, a transmutative method of reading the book of self, is expressive of both Newton's will to superiority and his ambivalent and complex placement of the female in his system of representation. Newton's theological literacy, a purifying method of reading scriptures, employs a hermeneutics using criteria of Enlightenment science to purge scripture of idolatrous complexity. That theological literacy Newton extends to the world of politics in his work at the London mint, where he purifies the mint of inefficiency and the underworld of counterfeiters. Newton's overall method of working in seemingly opposed systems of representation is juxtaposed to Niels Bohr's "Unity of Knowledge," with both demonstrating a Kierkegaardian "dance of the absurd" in their productive use of contradiction. However, Bohr's complementarity accounts for and goes beyond the limits of Newton's approach. Employing Bohr's complementarity as meta-epistemological frame, Walter Benjamin's method of constellation, Werner Heisenberg's uncertainty principle, and Kurt Gödel's incompleteness theorem are positioned as three post Enlightenment responses to Newton's characteristics of science outlined in his "Rules of Reasoning." Mutually

exclusive yet interdependent, these epistemological complementarities are framed as possibilites for construction of a human(e) science

CHAPTER ONE

INTRODUCTION

In 1696, Sir Isaac Newton, already famous for his Principia, left his sinecure as Lucasian Professor of Mathematics at Trinity College, and went to London to work for the national mint, where in a few years he would rise to the position of warden. Unsurprisingly, given his overt commitment to the principles of Enlightenment science, the obsessively methodological Newton began with time-management studies, carefully calculating each laborer's tasks with an eye towards maximizing efficiency of the mint-as-machine. Surprisingly, given Newton's almost legendary withdrawal from social activities, he also developed and ran a kind of Gestapo aimed at ferreting out counterfeiters, even going as far as wearing disguises himself, and mingling with London's notorious underclass (White 253-255).

For some, this small footnote of history is a sidelight to Newton's life, much less significantly related to the development of his ideas. At worst, the incident is a cluttering of the view of Newton as the romantic genius *par excellence*, who by definition operates in a lofty isolation, free to contemplate the music of spheres, without the especially cacophonous noise of the lowly masses. However, if one begins with the assumption that the nineteenth century view of the Enlightenment genius is a deceptive construction allowing for a radical desocialization of the formulation of ideas, this seeming sidelight to the story of Newton takes on different, and certainly more sinister, significance. By looking at Newton's work at the mint outside of the "terministic screen" of the Romantic genius, it appears reflective not of a tangent to Newton's course as a major figure of the early modern period but as that course's culmination, in that crucial elements of

Newton's ideas, drawn not only from his much touted Natural Philosophy, but also from his more clandestine studies in alchemy, and more importantly, his highly secretive work in Arian theology, come to a kind of materialized fruition in this episode, and Newton's hand is revealed: "he do[es] the police in different voices," as T.S. Eliot first titled his Wasteland.

Eliot's original title seems particularly apt for this work on several levels. First, implied in my general argument is that the modern—that which Eliot describes as a kind of desert of meaning, place, and agency—is informed greatly by Newton's works and their reception. That the modern is in part a "wasteland" is due, given "Newtonism's" unmistakable extensions into all disciplines, to Newton's work itself as a system of thought that is easily appropriated for dehumanizing ends. Secondly, the recovery of Pound's erasure of Eliot's original title, a title conjuring not a grand image of devastation but the smallness of desperate people, chatting of the inconsequential as they drain their cups, is akin to what I am attempting to encourage in my analysis: to recover what could be called the erased title of Newton's work: the "Mathematical Principles of (social) Purification." Finally, the phrase itself captures the general methodological trend in Newton's work: policing. This policing—this drive towards a radical purification—describes both a central ideological force across Newton's works and more critically helps explain that work's emergence in a socio-rhetorical field characterized as employed in the implicit modernist project of "domination and emancipation," (Latour 10), as Bruno Latour notes, carried out in Enlightenment science in part through a process of conceptual purification. This process, Latour adds, leads to a proliferation of hybrids. Ironically, given my read of Newton's method as a kind of covert hybridization (as well

as a kind of hybridization of co-versions), Newton's work both exemplifies Latour's description of the Enlightenment project and complicates it, suggesting not so much a supplantation of the premodern by the modern but instead a double move of remixing premodern principles and a simultaneous denial of those principles' genealogies. Latour's sense of purification is pervasively and forcefully apparent within Newton's science, his alchemy, and theology. Where Newton complicates Latour's conceptualization of modernist purification is how he constructs these seemingly isolated and partially opposed systems of representation: Between them, he employs a curious method of hybridization, in which ideas from one system inform another. However, this is always (and perhaps already) a hidden hybridization, and it is always (and certainly already) a directional hybridization, as it seeks to identify, through systematic removal of corruption, the God the Father of Newton's Arian theology.

Much more so than the apple-on-head story of the development of the theory of gravity, Newton's work as Warden of the London mint provides a productive figure that elaborates, in the very material world of money, men, and politics, what I see as crucial factors interacting to provide the context for the emergence of what has become known as Newtonian science and modern empiricism. These factors include a general method of rhetoric marked by sophisticated deception, a social context in which that rhetoric emerges characterized by dangerous struggles for power and class standing, an implicit yet persistent misogyny, and, finally, a drive for radical purification that necessarily presupposes pandemic corruption. It is the last—the drive for radical purification, whether of the physical world, as in Natural Philosophy, or of the self, as in Alchemy, or of the Book of God, as in Arian theology—that best describes Newton's efforts.

The central argument of this study is that Newton's work can be reconceived as rhetorical, in which he attempts systematic purification of a number of figurative and literal texts, including the book of nature, the book of self, and the book of God. What the mint episode reveals in part is what is at stake in this complex interplay of ideas: a very real set of consequences for lived experience, and those consequences include how we view and act on the world, our "selves," and our relationships with and conceptions of a higher being. Until relatively recently, Newton's ideas and the texts that demonstrate them have been subject to a curious process of construction in which Newton's Natural Philosophy—his "remarkable achievement" as I. B. Cohen says in his introduction to the Principia—has been treated not only as the primary contribution of Newton, but as more or less isolated from his "unfortunate" time-wasting in alchemy and theology (. More current "popular" biographies at least mention Newton's interest in alchemy, as well as his religiosity. For example, see Gale Christianson's Isaac Newton and the Scientific Revolution. This contemporary text, part of the Oxford Portraits in Science series, goes a long way to place Newton's ideas within the social matrix of his time. However, its overall presentation is modern: it implicitly isolates Newton's systems of representation from one another, and devotes the bulk of its presentation to his scientific studies, with a brief nod to his other endeavors.

What characterizes the traditional approach is a consistent down playing of connections across these systems. Conceptual inter-relationships are mostly ignored, hidden perhaps, under the overarching shadow of Newton's natural philosophical success. In short, the traditional approach creates a Newton thoroughly "modernized," so much so that he, and his method of science, have become nearly synonymous with the

modern. As late as the mid 1930's, Newton papers on alchemy and theology once offered to the Royal society were still classified as "not fit to be printed" (Dobbs and Jacob 11) and having "no scientific value," allowing them to be sold at auction as curiosities (White 3), demonstrating both the strength and the institutionalized nature of Newton's reception-as-exemplar-of-modern. Diagrammatically, traditional approaches to Newton's work in his three fields of study can be represented as in Figure One.

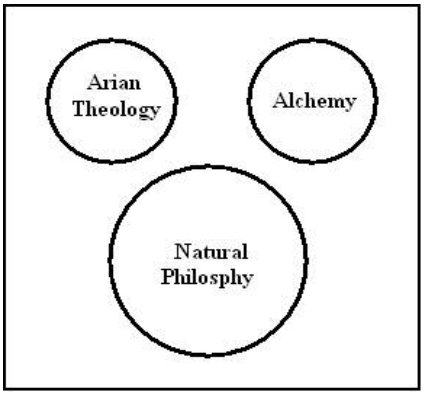

FIGURE ONE: TRADITIONAL STRUCTURING OF NEWTON'S REPRESENTATIONAL SYSTEMS

This approach is best exemplified by biographies such as Gleick's recent Isaac Newton, and Berlinski's Newton's Gift: How Sir Isaac Newton Unlocked the Secrets of the World, and to a lesser extent, Westfall's The Life of Isaac Newton. In the traditional approach, Newton's theology and alchemy are either ignored entirely, as in Berlinski's work, or at best frequently noted, as with Westfall, but not treated as a serious, much less critical, part Newton's systems-of-systems.

However, strands of Newton scholarship began to emerge that reconfigured the inter-relationships, and relative influence, of each of Newton's systems, as depicted in Figure two.

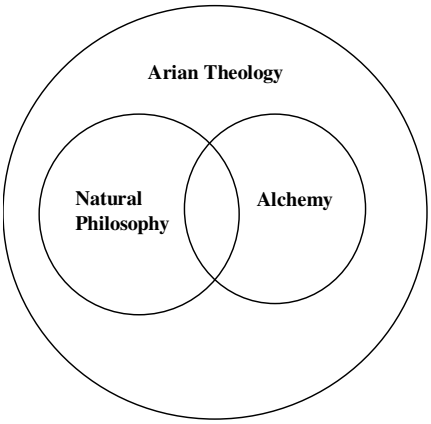

FIGURE TWO: CONTEMPORARY STRUCTURING OF NEWTON'S REPRESENTATIONAL SYSTEMS

Not until Dobbs' innovative scholarship examined the influence of alchemy on Newton's physics did this view of the thoroughly natural philosophized Newton begin to break down. In recent works, such as Markley's Fallen Languages, more deconstructive treatments have appeared that examine influences of both alchemy and theology on Newton's thought, as well as situating his work within the social and ideological processes of his time. Figure two best represents Dobbs' stance. Her approach is a kind of counterpoint to I. Leonard Cohen's, who has persistently argued that Newton's science was the result of deliberate isolation from other, especially "premodern," systems of representation. For Cohen, the Newtonian system, as he calls it, the "Newtonian style," is foundational in its isolation of systems of representation:

> The transformation Newton went through in relaxing the strictures of mechanical philosophy may have been in part motivated by alchemy, but it also required a new method that allowed him to continue maintaining the sharp distinction between experimental philosophy and the rest of philosophy, while nevertheless delving into the realm of unseen forces acting at a distance. I have called this new method the Newtonian

> style, developed to a high degree in the Principia. The elaboration of this style was a fundamental; part of Newton's basic philosophy that emerged in the 1680's. ("Some General Aspects of the Principia" Principia 62)

Cohen's framing of the issue of separation of systems is paradoxical. He admits that from the outset Newton's intellectual "transformation" involved a "relaxing of the strictures" of "mechanical philosophy," even one motivated by alchemical reasoning. On the other hand, Cohen has Newton maintaining the "sharp distinction" between systems, to the extent that the "Newtonian style" is defined by such conceptual isolation:

In contrast, Dobbs and Jacob argue for a much more complicated Newton:

> [Newton's] method was not limited to the balancing of those approaches to knowledge that still constitute the elements of modern scientific methodology, nor has one any reason to assume that he would have deliberately limited himself to those familiar approaches even if he had been prescient enough to realize that those were all the future would consider important. Because his goal was a Truth that encompassed not only the "mathematical principles of Natural Philosophy" but divinity as well, Newton's balancing procedure included also the knowledge he had garnered from theology, revelation, alchemy, history, and the wise ancients. (10)

Dobbs' corpus of work devoted to Newton's alchemy does go a long way to reinterpret Newton's systems of thought, and their inter-relationships—his "balancing" of systems, as she says—but her emphasis is on the alchemical portion of his work, his "literacy of self" as I have been calling it, and she does not make, though she frequently

asserts, the larger argument that all his systems can be subsumed under his Arian theology.

More pertinent to this study is Markley's work, Fallen Languages, where he argues that Newton's Natural Philosophy resulted in a shift of authorizing power from God to the experimental method, while simultaneously denying the theological basis of the power in the first place. The larger context for Dobbs', Markley's, and even Latour's respective approaches, is in an extension of the Enlightenment project into itself, at least into science's genealogy. "Science" is open for analysis in a "scientific" way, in which it is viewed as bi-directionally over-determined by the cultural, social, and psychological influences of its day. An historical moment that recognizes the emergence of this loose collection of approaches is the publication of Kuhn's Structure of Scientific Revolutions. This type of history of science has progressed (a most un-innocent term) to the point Kuhn's work itself is open for analysis via critical extension of the very method it employs. Implicit in what I am up to is such a general critique of Kuhn. He goes far in socializing science, but then retracts, especially in his "Postscript," from what is suggested by his use of the term "community" in relation to paradigm formation and maintenance. Kuhn is provocative as far as he goes in "socializing" science to a radical extent of daring to suggest other factors—human factors—determined what passed for good science and what didn't. For example, nearly avoiding entirely the issue of gender relations in his analysis, what emerges from his Structure of Scientific Revolutions most starkly is what is not signaled: at the minimum, a category "woman," outlined by its absence. Class, as well, is handled implicitly in Kuhn's analysis: I am left with a crude empiricism of adding up the players in science, estimating combined family income, and

realizing that whatever these Enlightenment figures were, they did not shop at seventeenth and eighteenth centuries equivalent of Wal-Mart. Additionally, the whiteness of the enterprise of science perhaps went-without-saying in Kuhn's treatment, but it shouldn't.

However, I also don't want to reduce Newton to any one of these complexes of influences of gender, class, or race. My sense is of a startling mix of these influences in Newton, at least in the sample of texts from his three "literacies." To tease this sense of complication and complex admixture out, I have chosen samples of Newton's writing as my primary evidence, and subjected them to a rhetorical analysis, and attempted to articulate that sense of purification and its attendant concepts.

"Rhetorical" is a key term here, and I am mindful of it. By rhetorical I mean to use a method to look at artifacts of a symbol system for their means and ends of persuasion, a definition clearly close to Aristotle's in On Rhetoric (36). However, such a definition avoids the larger issue of rhetoric: discourse's ability, as Foucault says, to inspire:

> respect and terror, to which all were obliged to submit, because it held sway over all and was pronounced by men who spoke of right, according to ritual, meted out justice and attributed to each his rightful share; it prophesized the future, not merely announcing what was going to occur, but contributing to its actual event, carrying men along with it, and thus weaving itself into the fabric of fate. ("Discourse on Language" 218.)

Note the characteristics of this "true" form of discourse: it exacts submission, it is tied to a person-speaker, it follows prescribed rules ("ritual"), it performs justice, and it

constructs the future. In short, it is a social act in the highest sense: "true" discourse largely creates, for better or worse, fate—and that is the fate of people themselves.

For Foucault, "true" discourse disappeared in the fifth century BCE, along with its practitioners, the Sophists, to be replaced by discourse where "the highest truth no longer resided in what discourse *was*, nor in what it *did*: it lay in what it *said*"[italics his] (218). That stance towards discourse disappeared, Foucault maintains, because discourse was perceived as "no longer linked to the exercise of power" (218). Significantly, Foucault doesn't remove power itself from discourse; he only tracks the erasure of the belief that the most ideal discourse constructs social reality via overt exercise of social power. The overt exercise of social power that characterized "true discourse," Foucault adds, was transformed into a "will to knowledge" that reached a kind of apex in Newton's time:

> A will to knowledge emerged [in the early Enlightenment] which, anticipating its present content, sketched out a schema of possible, observable, measurable, and classifiable objects; a will to knowledge which imposed upon the knowing subject—in some ways taking precedence over all experiences—a certain position, a certain viewpoint, and a certain function (look rather than read, verify rather than comment). (218)

In many ways, Foucault is describing the reception of Newton's approach, the extension of Natural Philosophy to encompass the whole of the human, even consciousness itself, which becomes the Enlightenment "self:" observed and observe-able, measured and measure-able, and classified and classify-able.

Newton's own rhetoric—what I call his "literacies" in the language of this dissertation—only on the surface promotes this detached empirical, purely ocular self. Instead, taken as a whole and treated as overlapping systems of persuasion, Newton's discourse, behind the veil of Natural Philosophy, attempts and in part succeeds in functioning as "true" discourse functions: it exacts submission to his will (e.g. he displaces contenders to his power such as Leibniz), it is authorized not by argument but by speaker (e.g. his ultimate authority is drawn from his placement of himself as God's translator), it follows prescribed rules (e.g. the "rituals" of furthering self interest via increasingly complex applications of a "disinterested" truth-value determination system), it performs "justice" (e.g. it punishes those who transgress, from counterfeiters in London to counterfeiters in the Royal Society) , and it "constructs" the future, a future that includes Newton as a superhuman avatar of science.

What both Aristotle's definition of rhetoric avoids and what Foucault's description of "true" discourse necessarily postpones is the question of persuasion and inspiration to what ends. Though Foucault's Sophists sound preferable to that which comes after, one lost attribute of true discourse—a holding accountable of the speaker to the polis—only describes a potential check against discourse inviting unethical ends, not a guarantee against subjectifying language. Therefore, my definition of rhetoric is more akin to Isocrates'. Isocratean rhetoric considers as central to rhetoric the formation, promulgation, and expressions of values. As Welch notes in the Contemporary Reception of Classical Rhetoric, "The corner stones of Isocratean rhetoric are the utilitarian appeal to many aspects of listener or reader and an emphasis on values, two ideas that diverged

from the Sophists, who sometimes confined themselves to exclusively utilitarian themes" (123).

To frame Newton's writing as "Isocratean Rhetoric" is to examine it for both its utilitarian rhetorical practices (its means) and for its expression of certain values (its end[s]), Framed in such a manner, Newton's literacies emerge as both reinforcing and drawing a fundamental warrant from an inter-locked set of values. The primary "conceptual" end, of Newton's writing, I maintain, is the embracing of one God the Father. The primary "social" end of his writing is the embracing a strict hierarchy in which Newton functions as a kind of pure human substance not only at near the top of the vertical continuums of corrupt to pure, base to celestial, female to male, but also as one authorized to purify the continuums. These two values, however, Newton necessarily hides in most of his writing: the former because it is at the center of the proscribed Arian heresy and the latter because of its opposition to the of Enlightenment ideal of "disinterested" science.

To recover Newton's rhetoric is re-place his texts as in conversation with the ideas and the social networks of the early Enlightenment period and treat them as rhetorical means to promote his value(d) ends.. The first problem one encounters in such a recovery is Newton himself, who goes far to hide his rhetorical tracks, both means and ends. At almost every public juncture, Newton isolates his most famous work—his science—from his other systems of representation, alchemy and theology. Additionally, Newton consistently in shared communications such as letters to members of the Royal Society claims his primary ideals are "disinterestedness" and "friendship."

That process of isolating Newton's science from his other works, as well from the socio-rhetorical field of his time, was continued after his death via the popularization of Newton's ideas in the form of redactions, epitomes, and summary books aimed at the emerging semi-literate lower middle class audience of the late eighteen and nineteenth centuries (Markley). Even this presentation, distribution and promulgation of a narrowed view of his ideas in these texts for the "masses" reflect Latour's twin Enlightenment tasks of domination and emancipation (Latour). The resulting isolation of Newton's ideas from the socio-rhetorical context serves to describe a science of both conformity and a-sociality, keeping those "masses" restricted to a laborer's practical application of laws, while also deceiving those masses into thinking the enterprise of science emerged outside of class structure. However, the very availability and accessibility of these redactions reflect the emancipatory task, in the democratizing of the "gist" of Newtonian science (Dobbs and Jacob 89-94).

It may be that for the modern scientist, the god term has become the experimental method, but for Newton himself, the experimental method is just one method of radical purification, appropriate for the corrupt natural world, but that draws its strength—its truth value determination validity—from a very un-modern sense of God, one that is less "crossed-out" in Latour's sense, and more hidden. The task for Newton was the task of the translator, and that translator was confronted with an array of corrupted texts, each requiring nearly mutually exclusive and yet conceptually interdependent methods of recovery of truth. That truth, as Newton states in the "General Scholium" to the Principia, is directly tied to discovering the real nature of God. Figure three depicts my overall context for Newton's three "literacies."

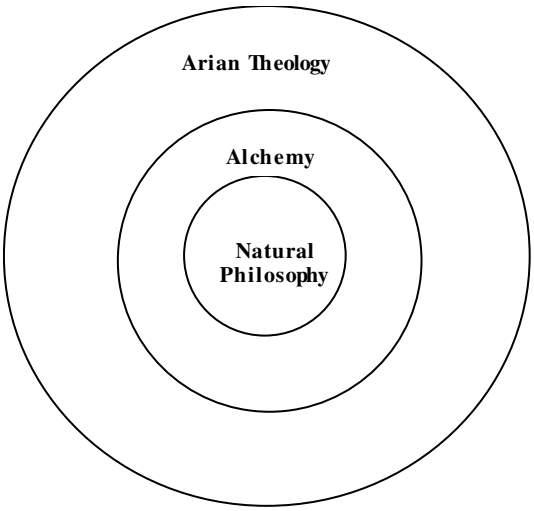

FIGURE THREE: NEWTON'S SYSTEM OF REPRESENTATIONAL SYSTEMS

In this approach, Newton's alchemy and Natural Philosophy are subsets of theology. What theorists, of both rhetoric and the history of science, have only begun to do to date is to approach Newton primarily as a theologian, whose Natural Philosophy's surface conceptual isolation from his other areas of interest and those other areas' central assumptions of what constitutes truth is in reality only a semblance of conceptual isolation. From Newton's end, the isolation is more a smart response to the political, social, and even psychological fields in which he develops his ideas and commits them to text. In short, the conceptual isolation of Newton's "science" from other systems at his disposal is as reflective of the particular discourse communities to whom he addresses his rhetoric as it is reflective of an implicit or explicit commitment to developing a grand system of knowledge manufacture. Two clusters of "facts" support my assertion. First, Newton faces deleterious material consequences for invoking ideas drawn from alchemy and Arian theology. Alchemy is an "occult science" in relation to the nascent science of the seventeenth century, whose formal community is embodied in the Royal Society. Invocation of alchemical principles results in a two fold police action: The alchemists themselves actively police their membership for expressions of secret knowledge, while

the Royal Society members—many of whom, like Newton, are more or less clandestinely involved in alchemical studies—actively police the discourses of its members for "occult" explanations. Newton's theology is even more dangerous to invoke: it is a heresy in the eyes not only of the Anglican authorities of his time but of the quasi- secular authorities as well, such as Newton's primary employer, Trinity College, whose very name proclaims its opposition to Arian antitrinitarianism. In many ways, Newton risked the designation of outlaw—an ideological criminal—in any overt attempt to invoke of his religion.

However, Newton does invoke these outlaw principles drawn from these two "unscientific" areas. These "slippages" between nearly mutually exclusive systems of representation are the second cluster of "facts" supporting my claim that Newton's science is not only more than it appears: it actively if sneakily violates some of the characteristics most scientists would have us believe it asserts. Sometimes, as I will develop in the following chapters, he slips directly—and even bravely—in the case of the alchemical principle of "action-at-a-distance" to explain gravity, and more often indirectly, as in his radical emphasis on "oneness" in his "Rules of Reasoning" in the Principia in outlining a method of knowledge construction.

Part of the problem with approaching Newton's Natural Philosophy, and in particular its genesis in the fluxing socio-cultural rhetorical field of the Enlightenment, is its very remarkable success Cohen mentions in his "Introduction" to the Principia. The Newtonian system of representation not only works singularly well at representing the physical world in most instances without recourse to a theological metaphysics; it works that way in large part by overtly policing against such recourse. Even Karl Popper's

focusing on falsification in the doings of science can be viewed as an elaboration of Newtonian science's "faithlessness" taken to the extreme: phenomena earn their existence through the repeated structured interrogations of the experiment, and the experiment is the penultimate desert of the modern, without self, spirits, or God.

Not so with Newton: my argument throughout this work is that, regardless of the world investigated, Newton's ideas are puritanically theological (as well as theologically Puritan), requiring a hermeneutics of law enforcement, in which the books of nature, the self, and even of God are put on the rack of translation. The structure of this work reflects my own sense of hierarchy implicit in Newton's endeavors. Newton's "highest" system is theological: there, the text, the Bible, is more pure than impure. The next highest system is alchemical: that text, the self, is not so much more pure than impure as it is capable, in part as modeled by Jesus, God's first "perfect creation," of transmutation to a higher metal of being, so to speak. Newton's "lowest" system is Natural Philosophy, his science. That text, nature herself, is far more impure than pure, and worse: unlike the alchemical "self," nature, ever the fallen woman, cannot be redeemed. What can be redeemed are vestiges of perfection, and those vestiges, if one follows Newton's rules of reasoning to their logical extension, are always global, always impersonal, always Platonic, in that the overall form of the law is privileged over its specific manifestations, which are rhetorical slaves to the master theory.

In light of my sense of the above hierarchy, I begin in Chapter Two by looking at Newton's operations at the basest level, with the crudest text: Natural Philosophy. In this chapter, I approach Newton's development of his science, especially as evinced in the Principia, as in part a consequence to psychological, social, and political forces at work at

the time. I begin with Newton's first formal interaction with the Royal Society, describing his interactions with Robert Hooke, the Society's Secretary. What emerges from a rhetorical analysis of a number of letters between Newton, Hooke, and other Royal Society members is a consistent presence of three key elements in Newton's discourses: *crypticity*, a mode of rhetoric overtly referential and disinterested while covertly persuasive and self-interested; *Oneness*, a foundational belief in a radically hierarchicalized design of the world; and *purification*, a general pattern of method characterized by systematic policing of corruption to purify the physical, spiritual, and (psycho)social aspects of the world. These elements mark his Principia as well, and are taken to their highest—and deadliest—level in Newton's treatment of Gottfried Leibniz over the issue of the calculus' authorship.

In Chapter Three, I address selections from Newton's alchemical work in light of the text under interrogation in that system: the self. Here, I argue, may be Newton's most interesting text to be translated, and his strangest literacy. A "reading" of this text, in a Newtonian alchemical sense, requires the construction of an eldritch self: on the one hand, it is clearly a text "immaterial," and therefore radically separate from the baser text of the world. On the other hand, the central activity of the alchemist is a transmutation of that self that is paralleled by a transmutation of concrete elements of that baser world.

Strange gender relations, or at least strange deployments of gendered metaphors, pervade his alchemical work, as particularly demonstrated in his "Commentarium" on and translation of "Hermes," a central alchemical text for sixteenth and seventeenth century would-be transmutationalists. Newton's focus on *Oneness*, in both his construction of his rules of consequence, and in his overall method justified in the

"General Scholium" to the Principia, also infect this system, further complicated by that *Oneness*' identification with "God the Father." Unlike his Natural Philosophy's "literacy," this method of *purification* results in a very odd dialectic between *a priori* and *a posteriori* methods of truth-value determination. In this system, Newton is scholastic in the sense that he operates on the assumption of past knowledge, ascertainable through the reading—and literal translating of—alchemical authorities, and his method, obvious even at the level of asserting claims and then deploying textual "proof," is overtly *a priori*. However, in the alchemical experiment itself, carefully and methodologically recorded in Newton's numerous notes, this *a priori* knowledge is tested through *a posteriori* means. This play with opposing methods, which I trace in this chapter, is related to the goal of alchemy: change of the self. That self, I argue in the chapter, is more than a theoretical construct: Simply, it reflects well his own sense of position in family, society, and the universe at large. In the end, three pathologies emerge: one of Newton himself, who suffers what has been romantically termed his "Dark Year" of 1693. The second pathology is the construction of category woman in his female tropes. In that rhetorical patterning in his alchemical texts, Newton constructs for category woman a "specificity and materiality of difference" reflective of his psychological ambivalence to women and his conceptual equation of female and corruption (Jarratt 9). The third pathology is of Newton's overall system of systems itself, which is predicated upon a strict hierarchical relationship with the world, other people, and god.

In Chapter Four, I approach a small sample of Newton's overtly theological texts, especially works relating to methods of prophecy. With this literacy, Newton is reading

the highest level of text: the Judeo-Christian Bible, especially the Old Testament. This method of reading is Newton's most politically dangerous, as he cannot directly assert his heresy. Yet he is working at, what I claim throughout this book, the text containing not just the most purity of all but the only text inherently capable of expressing true purity, from which the lesser texts of self and of nature can at best only partially emulate.

In these texts, the vertical continuums addressed in the prior chapters, of female to male, of *a posteriori* to *a priori,* of base to transcendent, of local to global, and particularly of corrupt to pure, are explored at their hierarchical peaks, so to speak. In this system, the bible is approached as a text akin to nature, and direct observation is more deductive than inductive, as it begins with the critical premise of a God the Father discrete from a god the son, and covertly observes from that conclusion as Newton's text itself overtly appears to be arriving at that conclusion after analysis. What emerges is a totally masculinized single God the Father, who simultaneously stands unreachably above the baser texts, yet ultimately provides both their fundamental basis as well as their key for redemption-through-literacy. More importantly, Newton's complex literacy of the book of God, when "materialized" in Newton's work at the London mint, reveals itself as a method for and justification of a radically hierarchical social system, with Newton as the master geometer of society, controlling the force of society: money itself. What emerges in this analysis is the possibility of a fourth Newtonian literacy, one in which the text is people, and the translating also involves a programme of purification.

In the fifth chapter I explore some of the limits inherent in Newton's system of systems, by offering a counterpoint to his theory suggested by the work of Niels Bohr.

Using Kierkegaard 's concept of "dance of the absurd" as a starting point, I argue that both scientists practice a similar conceptual play in their respective approaches to seeming oppositions or contradictions, and both approaches are forms of Bohrian complementarity. In Newton, this complementarity is immature, as the vertical hierarchy of truth-value constitutions presupposes a ranking of "truths," and these rankings are inextricably bound in assumptions about race, class, and gender. As such, Newton's complex handling of multiple systems of representation remains more a demonstration of the limits of Enlightenment thought, especially science, rather than a model for future inquiry. In the end, Newton's epistemology of epistemologies is contractive, "always and everywhere," to appropriate his recurrent phrase from the "General Scholium" to the Principia, pointing back to a white, male, Old Testament God-the-father.

In contrast, Bohr's horizontal hierarchy seeks a "unity of knowledge" rather than a "unity of truth," and as such offers an expansive model of knowing, in which foundational truths are replaced by ensembles of seeming oppositions, open to a kind of dialogic of understanding. Noting Plotnitsky's comparison of Bohr's approach to Bataille's General economics and Derrida's post-structuralism, I argue that not only does Bohr's method carry with it much of the explicit critique of Enlightenment thought that these post-modern responses articulate, he also provides a check against excessive relativisms through an unclearly articulated yet nonetheless implicit redefinition of the relationship between knowledge, experience, and language.

As is outlined in Newton's "Rules of Reasoning" in his Principia, the natural philosopher must follow a "recipe for legitimacy," and that recipe not only presumes but imperiously demands a radical "objectivity," in which the experimenter's ethos is directly

proportional to "His" invisibility. And throughout, the three primary characteristics of Enlightenment science that Schleifer notes—simplicity, generalizability, and verifiability—are implicit god terms (36). In the sixth and final chapter, I return to those principles and offer as "post modern responses" Walter Benjamin's *constellation*, Werner Heisenberg's *uncertainty*, and Kurt Gödel's *incompleteness*. Using Bohr's complementarity and his meta-epistemological concept of "Unity of Knowledge," I position each of these responses as both expressions of and resolution of some limits of Newtonian science. Each response involves a three-fold move: an exposure of epistemological inadequacy, a re-introduction of the human into the system, and an expansion, rather than a displacement, of what could be called the epistemological frame.

Projecting a History of the Future

As in the beginning of this introduction with my presentation of the adult Newton at the mint, I use a single incident from Newton's life as a kind of demonstration of what kind of man we have rewritten into a model of sustained "scientific" inquiry into the world. The incident is one from his childhood that Newton related in a letter to John Locke a quarter of a century later, and I quote at length here to offer a flavor of Newtonian science as performed by and on the man himself:

> I took a bodkin, and put it between my eye and the bone near to the backside of my eye as I could: & pressing my eye with the end of it (so as to make the curvature in my eye) there appeared several white, dark and coloured circles. Which circles were plainest when I committed to rub my eye with the point of the bodkin, but if I held my eye and the bodkin still though I continued to press my eye with it yet the circles would grow faint

> often disappear until I resumed them by moving my eye or the bodkin. (qtd in White 61)

Here, I argue, is an example of science outside of concern for the human, where the "clockwork" universe is extended, as it is to the workers at the London mint, where Newton machined both the workers' behavior and that of the underclass of counterfeiters, and as it was at Los Alamos, where bets were made before the initial blast about whether the "experiment"—the objective structured and controlled observation of nature—would start a chain reaction which would end all life on the planet. Newton, White notes, in using such "pure" science nearly ended his career before it could begin (White 61). As an "embodied" metaphor for the practice of science on the body of humankind, the incident suggests there a very real possibility that a science without an implicitly compassionate ethics is likely to destroy that which it ostensibly desires to know: nature, both "the tiny fragile humans" and the rest of our kin, from trees, to animals, to the cerulean sky shot through with migrating geese. Newton's recounting of the bodkin experiment, I maintain, reveals both the strength and the danger of extending empirical "objectivity" into the world of living things, of "Putting nature on a rack and torturing out her secrets," as Bacon would have it, without thought to the fate of most victims of torture: prolonged pain, followed by death.

Benjamin notes in "On Language as Such and on the Language of Man," the act of language completes creation, a creation he assumes is begun, in part, in the writing of the same scriptures to which Newton devoted so much attention. Benjamin, as well, could be said to outlining a method of reading the book of nature, but what he says of nature is

shot through with a lyrical sadness, compassion, and responsibility. “If nature could speak,” he says,

> It is a metaphysical truth that all nature would lament if it were endowed with language. This proposition has a doubling meaning: It means first: she would lament language itself. Speechlessness: that is the great sorrow of nature (and for the sake of her redemption the life and language of man—not only, as is supposed, of the poet—are in nature). This proposition means secondly she would lament, lament, however, is the most undifferentiated, impotent expression of language; it contains scarcely more than the sensuous breath…. Because she is mute, nature mourns. (329)

Benjamin exhibits the same feminizing of nature as did Newton and so many of the Enlightenment philosophers, but in Benjamin what is drawn out is not a chaotic sexuality, or an inherent weakness, or especially a need to be “tortured on the rack,” but instead an eerie focus on silence when creation itself is implicated in the use of language. This is a far cry from both the Newton-engendered report and the Bible as transcendent truth tale.

I am taken with Benjamin’s material sense of history, and his critique of modernity in “Storyteller.” In that piece, Benjamin notes that after the World War I, men returned from the battlefield incapable of relating experience, and “information” replaced “wisdom” as a kind of currency borne by a language no longer functioning as the weave holding society together but instead as a means of deadening response-ability. WWI, for Benjamin, stands as a dramatic convergence of ideological forces, the technologies that spun off and reinforced those ideologies, and a marker of significant limits of

Enlightenment thought. Newton's calculus, as just one example, provides the necessary language of ballistics, which reaches new heights of application and new depths of nightmare in trench warfare, so aptly described by Erich Maria Remarque in All's Quiet on the Western Front. There, in the narrator's alternatively dry reportage of discarded limbs and stomach wounds with his frenzied ravings that never quite match up to the described horror, despite their rhetorical intensity, the voice of the Modern is loudest. And that voice, with its detachment from body so hilariously parodied in Gulliver's endless accounting of his daily output of shit and piss, is now not so funny as it attempts to keep up with the accounting of loss. There is no surprise to find at the end of All's Quiet that the narrator is dead, and that this news is delivered as a statistic, a little error variance to be expected as he is just a part subsumed under the larger whole of the machine of modern warfare.

No wonder Kafka, in part in response to this horror, when asked if there was any hope is said to have replied, "Yes. Just not for us." I agree with Kafka to an extent, but feel compelled to qualify that lost hope by saying that it cannot be found in the endless elaborations and recapitualitions that emerge as modern warfare, market-objectification, and an increasing sense that, as Benjamin says, we cannot speak of our experiences. Nor do I see any hope in a looking backwards to a long lost pre-modern, with its jungle world of purposeful rocks and geocentric astrophysics that serve the primary purpose of maintaining a hierarchy of folks. Instead my analysis of Newton is driven by its ends, and one of those ends is a concern with the extent that Newton lives on in all of us, at the more formal level of what constitutes good scholarship in the academy to the less formal

yet probably more crucial level of the lived experience of the "tiny fragile human body" of which Benjamin writes on "Storyteller:" you and me, all of our children.

So my stance throughout this work, as much as possible, has been to emulate Benjamin's image drawn from Paul Klee's painting Angelus Novus, and to invite the feel of progress as wind that drives me farther and farther away from the series of actual catastrophes constituting the real subject, or at least the appropriate artifacts, for a Benjaminian way of doing history. My history is rhetorical in both the sense that I have approached his texts to uncover Newton's means and ends of persuasion—his "rhetorics"—and I position Newton's "rhetorics" as they elaborate in his literacies as covertly engaged systems of persuasion, all of which are implicated in the genesis of the what has come to be known as the Modern, especially modern science. I admit freely to participating in the same Enlightenment project for which we are both blessed and cursed by Newton. There is more than a little effort to "purify" the traditional view of Newton in the following pages.

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CHAPTER TWO

NEWTON'S NATURAL PHILOSOPHY: CRYPTICITY, ONENESS, AND PURIFICATION

> There is yet another argument for a Deity, which I take to be a very strong one, but till the principles on which it is grounded are better received, I think it is more advisable to let it sleep. (Isaac Newton. "Letter I." 1692. *Four Letters from Sir Isaac Newton to Doctor Bentley Containing Some Arguments in Proof of a Deity.* 291.)

> To make this system therefore, with all its Motions, required a Cause which understood, and compared together, the Quantities of Matter in several Bodies of the Sun and Planets, and the gravitating Powers resulting from thence; … Planets could revolve about the Quantities of matter in the central bodies; and to compare and adjust all these Things together, in so great a variety of bodies, argues that Cause to be not blind or fortuitous, and very well skilled in Mechanicks and Geometry. (Isaac Newton. "Letter I." 1692. *Four Letters from Sir Isaac Newton to Doctor Bentley Containing Some Arguments in Proof of a Deity.* 292)

> So then it was one design of the first institution of the true religion to propose to mankind by the frame of the ancient temples, the study of the frame of the world as the true temple of the great God they worshipped… So then the first religion was the most rational of all others till the nations corrupted it. For there is no way (without revelation) to come to the knowledge of a deity but by the frame of nature. (Isaac Newton. *Yahuda Manuscript*. folios 6-7. 41)

> To sum up:
> (1) We know, as a matter of record, that science under Fascism became sinister. (2) We are repeatedly being admonished that there is a high percentage of fascism in our own society. (3) Why, then, should there not be, in our society, a correspondingly high incentive to sinister science? (Kenneth Burke, *Rhetoric of Motives* 35)

The first quote is curious. Rev. Richard Bentley had received an endowment from Robert Boyle's will to deliver a series of lectures using Natural Philosophy to prove or at least reconcile the idea of a deity with the dramatic findings of eighteenth century science. Bentley, a lifetime supporter of Newton, had requested Newton's assistance in both reading the Principia and in using its material for the lectures. As last line of Newton's first letter to Bentley concerning using the Philosophiae Naturalis Principia

Mathematica (Mathematical Principles of Natural Philosophy*)* as part of a theological argument, it suggests Newton is either holding a "scientific" argument in reserve, or feigning such. The circumstances surrounding this quote make it even more curious. Bentley, one of the few contemporaries with whom, according to Westfall, Newton "exchanged honest theological opinions," (238) would seem to be the best audience for any theological explanations. Yet Newton deflects Bentley's questioning concerning god and science, both in this letter and in others.

In contrast, in the second quote, taken from another of his series of letters to Bentley, Newton maintains that the initial Cause, the granddaddy of all subsequent rule-based planetary motion, is neither "blind nor fortuitous," and must be "very skilled in Mechaniks and Geometry." And the third quote, taken from Newton's unpublished theological writings, asserts boldly that two ways are possible for "knowing God"—revelation, the specific subject of his theological writings, and "thru the frame of Nature," the subject of Newton's Principia, Opticks, and other Natural Philosophical writings.

A key that allows an understanding of these three quotes is hidden in the fourth quote, from Burke, who syllogistically arrives at the question/conclusion that science may be "sinister." "Sinister" Burke equates with fascism, conjuring up images of lab-coated policeman, a clipboard in one hand and Billy club in the other, working mainly in secret to enforce a brutal order. This is far from the usual image of Isaac Newton, and even farther from any traditional sense of "science." On the face of it, Burke's quote, though provocative, seems unrelated to Newton and science in general, with perhaps the exception of the horrifying practices such as Mengele's Nazi-sanctioned experimentation on human subjects, but even then only as proofs—exceptions—of a general rule of "fascism-free" science.

However, when the Principia and related texts are approached rhetorically, that is, as both ways to come to know God and as expressions of the specific social matrix in which Newton finds himself during the late seventeenth and early eighteenth centuries, then Burke's quote makes sense. Simply, given Newton's radical Arian Puritanical Heresy, coupled to his "fascistic" experiences with various members of the Royal Society, the Principia, the bible of science itself, emerges as a coded fascist manifesto, drawing its authority from a "hidden," patriarchal God, obsessed with corruption and purity, and implicitly encouraging Bacon's stark directive to "put nature on a rack and torture out her secrets." More critically, Newton's Natural Philosophy, arising as a kind of negotiation between systems of inquiry and the particular psychosocial matrix in which Newton found himself in the eighteenth and nineteenth centuries, has significant implications for the state of the "tiny fragile human body" for which Walter Benjamin laments in "The Storyteller" (84). Those implications are both figurative, as Newtonism reinforces the trope of the machine-body, and literal, as Newtonism with its vast power of control of the material world, makes possible the very technology underlying the machinery of modern warfare Benjamin viewed as a kind of catastrophe hiding behind a delusion of progress.

On method

Several assumptions inform my hermeneutics. First, the issue here is neither science nor theology. Rather, it is the human; that is, if both conceptions of nature and conceptions of God offer potential semiotic contrasts and combinations for construction of the category "human," then neither a scientific nor a theological approach is productive, except as further examples of semiosis. Secondly, given the first assumption, a productive analysis of Newton's work is then necessarily rhetorical, that is, looks to

uncover constructions of category human inferred or directly invoked by displays of discovering "the available means of persuasion," as Aristotle defines rhetoric in On Rhetoric (36). Thirdly, Newton demands a "brush against the grain," as Benjamin asserts in "Theses on a Philosophy of History." Benjamin writes in "Thesis VII,"

> There is no document of civilization that is not at the same time a document of barbarism. And just as such a document is not free of barbarism, barbarism taints also the manner in which it was transmitted from one owner to another. A historical materialist therefore dissociates himself from it as much as possible. He regards it as his task to brush history against the grain. (256-257)

One of the elements of Benjamin's historicism is a focus "on the image of enslaved ancestors rather than that of liberate grandchildren" ("Thesis XII" 260). This last assumption is not insignificant: it has been my sense throughout my reading of both the icon himself and his endless biographers, critics, and historians that there is both a tradition and a Newton-instigated trend to construct him as something more than human. This view of Newton as not *a* but *the* exemplar of science infectiously extends to science itself, making of its history, praxis, and process a supra-human enterprise. The elaborations of that suprahumanization of science are numerous, ranging from an educational process that stresses following in the prescribed footsteps of the greats (e.g.—endless replications of experiments for which we know the results, less exercises in knowledge construction than emulative and adulatory rituals with test tubes, fetal pigs, and Lilliputian pulleys), to the twin disdain for the "soft" (i.e.,, social) sciences and the humanities. To disrupt that process of suprahumanization, a new way of reading is

demanded. Cheryl Glenn[1], in Rhetoric Retold, eloquently argues for a more open historicism:

> We must risk, then, getting the story crooked. We must look crookedly, a bit out of focus, into the various strands of meaning in a text in such a way as to make categories, trends, and reliable identities of history a little less inevitable, less familiar. In short, we need to see what is familiar in a different way, in many different ways, as well as to see beyond the familiar to the unfamiliar, to the unseen. (7)

Glenn's approach underscores my sense that Newton's work in the three areas of Natural Philosophy, alchemy, and theology involves more than an early scientist exploring multiple systems of representation, and then discarding two—alchemy and theology—in favor of the third: science. Instead, Newton's system(s) are hierarchically arranged with multiple vertical continuums implicated, including corrupt to pure, female to male, ignorant to knowledgeable, and nature to heavens. Newton's systems viewed in this frame emerge not as in a Bahktinian dialogic relationship, with competing centripetal and centrifugal forces revealing a tension between "unitary language" and "social and historical heteroglossia" (Bahktin 272). Instead, the seeming contradictions in Newton's

[1] There is a curious paucity of women writing on Newton's rhetoric, particularly on his Natural Philosophy. The few whose analyses could be framed as close to "rhetorical," such as Dobbs and Jacob, still take as their primary disciplinary stance philosophy and history of science. More overtly feminist rhetorical analyses of Enlightenment figures, such as Jamie Barlow's, "Inventing a Feminist Discourse: Rhetoric and Resistance in Margaret Fuller's Woman in the Nineteenth Century" and Annette Kolodny's "Daring to Dialogue: Mary Wollstonecraft's Rhetoric of Feminist Dialogics" tend to focus on the rhetoric of the women of the nineteenth century, rather than on the scientific "giants" of the seventeenth and eighteenth centuries. Similarly, extended treatments of rhetoric and language of the Enlightenment, such as Catherine Hobb's exemplary Nineteenth Century Women Learn to Read and Write, tend to focus on women's gradual emergence as practitioners and developers of their own forms of early modern discourse, rather than on the rhetorics of the men. Hobbs' Rhetoric on the Margins of Modernity is a notable exception, providing rigorous rhetorical analysis of the writings of early Enlightenment male figures that worked on the fringes of seventeenth and eighteenth century Natural Philosophy. One hopes for comparable treatments of Newton by women scholars in the future, perhaps employing similar feminist rhetorical methodologies applied to classical male rhetoricians/philosophers, such as Welch's Contemporary Reception of Classical Rhetoric and Jarratt's Rereading the Sophists.

texts only appear contradictory when "science," perhaps Modernity's core unitary language, is treated as the ostensible goal of Newton's inquiry. Seeming dialogic tensions, such as the issue of the "occult" quality of Newton's concept of action-at-a-distance, reflect Newton's success in keeping secret his larger agenda, as well as underscore the general reception of "science" as a conceptually isolated system of representation.

If Newton's approaches are conceived as types of literacies, each with both its corresponding texts as well as rules for ciphering and de-ciphering, what emerges in the analysis are consistent double-moves, in which a surface conformity to the overt literacy is subtly supplemented by slippages from the other literacies. By "slippage" I mean a process whereby Newton invisibly deploys crucial and even foundational principles from one area of inquiry in another area of inquiry, and uses them not as ancillary concepts but as the crux of the other system's authority to speak truth. The Newton that emerges from this complicated method of reading and writing the worlds of nature, self, and God is more than "not quite a Newtonian," as Miller says in his "Introduction" to The Bentley Letters (277). Instead, he is always and already a Newtonian, an alchemical theologian, producing natural philosophic writings as a complex ensemble of multi-leveled codes that seek at the overt —and base—level to translate the "Book" of nature into a clear accounting of physical processes while at a covert—and apotheosic—level seeking to translate that Book into an authorizing text for Newton himself translating into something close to "perfect creation." Newtonian science, in the hands of its progenitor himself, is really a subservient part of a larger system of knowledge construction. That larger system, reflecting a fundamental belief in a "Unity of Truth," (Dobbs and Jacobs 9) aims only superficially at knowledge for knowledge's sake. Instead, Newton uses methods of

natural philosophic knowing as means to a theological end: the demonstration of a very peculiar and Newton-specific god. That Newton-specific god, as the constellation of grounding principles for all three of Newton's literacies, provides a way to recontextualize Newton's system(s) of knowledge to understand how "science," as it has come to be practiced, lends itself to "sinister" and "fascist" applications, as Burke notes in the last quote above.

In this chapter, I examine moments in Newton's natural philosophical and related texts where slippages from his other systems, alchemy and theology, appear most obvious. My approach throughout is not to begin with the assumption that Newton was "Newtonian," in the sense of having a purely mechanistic, skeptical, and empirically grounded view of the world. In part, I am following up on Markley's comment in Fallen Languages that Newton's science, which he sees as one of several forms of "Physico-Theology" developed in the seventeenth and eighteenth centuries, as it came to be defined initially drew its basic truth-value power from Newton's Arian theology, but subsequent permutations of the system shifted that power to the experimental method itself, while simultaneously denying the theological basis of that power in the first place. This process, according to Markley, is not a simple matter of eighteenth century science becoming "more secular; theology is not exorcised from the corpus of Newtonism but repressed within it" (Markley 183-184). In this light, receptions of Newton's ideas by scientists who came after him effected a crucial transformation of Newton's complex theological-philosophical system, with its own ontology, epistemology, as well as ethics and aesthetics, into a cruder atheological philosophical system, in which categories such as ontology and epistemology collapse, and what we are left with is an empiricism whose powerful means could be said to almost overwhelm its articulatable ends. Ethics, in

particular, are simultaneously erased and reinscribed as a form of mechanical subjectification, with "scientific management" as just one example. Because of this shift of power from a transcendent authority to an immanent "authorizing," a conceptual chasm develops in that Newton's science, a complete philosophical system when viewed as a complex mix of science, alchemy, and theology, is reduced to just "science." Hence my method is more an attitude towards Newton, attempts to explicate and apply a context for understanding Newton that is driven by the end of making his entire works "normal," that is, internally consistent, (psycho)logical, and socially-saturated. Those last two criteria—(psycho)logical and socially saturated—require positioning his texts as responses not only to eighteenth century natural philosophical questions but also more critically to the often socially dangerous demands of his peers, the emerging community of scientists. In that frame, three key elements emerge in Newton's "discursive" interactions with his world. One element is *crypticity*, a mode of rhetoric overtly referential and disinterested while covertly persuasive and "interested." Another element is *Oneness*, a theologically based foundational belief in a strict hierarchical design of the world. The final element is purification, a general pattern of method characterized by systematic policing of corruption to purify all aspects of the world, including the physical, the spiritual, and the social.

On Arianism

Given my placement of Newton's theology as at both the top of and subsuming his Natural Philosophy and his alchemy, it follows that Newton's Arianism both influences the development of his science and also outlines the "ends" of all his discourses. Arianism, a heretical Puritan theology first taught by the fourth century Alexandrine monk Arius, maintained that God the father and Jesus were separate

substances, a point countered by the Bishop of Alexandra, Athanasius, at the council of Nicea in 325. The "official" resolution of this point of theological dispute was the adoption of the notion of *Homoousion*, that is, the belief that Jesus and God the father are the same substance or entity, by the Catholic Church, and maintained as well by most official branches of Protestantism (Westfall 123). In Arianism, Jesus, rather than being a commingled Son of God, and therefore not God, is instead God's first perfect creation (White 149). Since the official word, first promoted by Catholicism and then carried on by the Protestant reformation, is that the three-in-one God is the correct translation, the Arian heresy underscores both the "corruption" of texts via translation of those who would call themselves authorities on God, and the need for covert promotion of the truth.

By the eighteenth century, Arianism was an underground religion, and an official heresy whose promulgation could result in variety of sanctions. Along with Roman Catholicism, Arianism was specifically excluded from the protections afforded by the Toleration Act of 1689 (White 234). Newton, as a fervid if underground advocate for Arianism, found himself in a dangerous position, especially as Lucasian professor at Trinity College, whose name itself reflects the secular and religious prescription of Trinitarianism, as well as the proscription of Arianism. Newton's sidestepping of the requisite ordination that comes with the professorship, in which he managed an unprecedented dispensation from the king while never revealing his Arian protest (White 150-151) demonstrates his overall strategy of covertly maintaining a radical theological stance while overtly seeming to be occupied with other interests, notably the burgeoning Natural Philosophy of the Enlightenment period. Even Newton's written output broken down by field supports this claim: more of his overall writing, according to one estimate 1,400,000 words, is devoted to theology than either alchemy or natural science, yet the

bulk of his published work, at least during his lifetime and until the latter half of the twentieth century, was in the least "written" area: natural science (73).

Partially because of the danger of publicly advocating for Arianism, Newton is invited to practice a method of reading-the-world characterized by rhetorical subterfuge. In Natural Philosophy, he is not so much working outside religious metaphysics as he is subtly avoiding promulgation of the directing of such inquiries towards the larger seventeenth and eighteenth century assumed goal of "proving" the existence of a very Christian and very Trinitarian god—Bentley's task in fact. This task Newton can neither support whole-heartedly nor completely avoid, as the opportunity is both for covert proof of an Arian God and for overt assistance with a discernible Enlightenment project, which at least in its early stages, involves the coupling of a Christian theology with the emerging Natural Philosophy (Latour 33). Newton, however, doesn't deal only with the community of Trinitarians: he has to contend with the Natural Philosophers of his time as well, largely embodied in the Royal Society. Their book—the book of nature—has also a method of literacy, and that method could be said to read the world through the lens of generalizability, accuracy, and simplicity, as Ronald Schleifer describes the three primary characteristics of Enlightenment science in hisAnalogical Thinking . Established in 1660 by Charles II, the Society took as its motto *Nullius in verba* (Not by word of mouth), highlighting from the outset the society's belief in the experimental method, and not lore or anecdotal observation, as the method *par excellence* for determining the real.

Structure of this Discourse

To get at the complex set of psychological, social, and philosophical factors giving rise to Newton's Natural Philosophy, I somewhat arbitrarily divide my argument into three subsections. In the first section, I describe Newton's first formal engagement

with the British Royal Society, arguing that Newton's treatment by and of his peers invited Newton to perceive science as a competitive enterprise in which public expressions of scientific findings involved less persistence in objective knowledge construction than clever, if not brilliant, overt and rigorous scientific knowledge construction slaved to a larger end of social hierarchy manipulation. In the second section, I argue that Newton's most famous Natural Philosophic text, the Principia, in light of its social surround, functions not only as an overt presentation of a complete system of knowledge construction but more importantly as a text designed to maintain Newton's placement of himself at the top of the social hierarchy. In the last section, I argue that Newton's treatment of Gottfried Leibniz when Newton is at the height of his career reflects Newton's real agenda: to use the ostensibly disinterestedness of the scientific community to serve his self interest, specifically, his agenda to make himself a kind of lord of science.

Constructing Community I: Hooke(d) on Hierarchy

In his "Postscript" to The Structure of Scientific Revolutions, Kuhn, responding in part to "reiterated criticisms" of the text seven years earlier, defines a scientific community as follows:

> A scientific community consists, on this view, of the practitioners of a scientific specialty. To an extent unparalleled in most other fields, they have undergone similar educations and professional initiations; in the process, they have absorbed the same technical literature and drawn many of the same lessons from it. Usually the boundaries of the standard literature mark the limits of a subject matter, and each community ordinarily has a subject matter of its own. There are schools in the

> sciences, communities that is, which approach the same subject from incompatible viewpoints. But they are far rarer there than in other fields; they are always in competition, and their competition is usually quickly ended. As a result, the members of a scientific community see themselves and are seen by others as the men uniquely responsible for the pursuit of a set of shared goals, including the training of their successors. Within such groups communication is relatively full and professional judgment relatively unanimous. Because the attention of different scientific communities is, on the other hand, focused on different matters, professional communication across group lines is sometimes arduous, often results in misunderstanding, and may, if pursued, evoke significant and previously unsuspected disagreement. (177)

I quote at length because this definition, more than any other, presents both the idealized surface of the "scientific community" of Newton's day, embodied in the British Royal Society, as well as hints at its behind-the-scenes social machinations. This definition is scintillatingly dialogic. As Kuhn tries, with considerable centripetal rhetorical force, to make of science a "special" field, "unparalleled" in its adherence to a textual canon, where quick and decisive "competition" of ideas determines truth, and where the members "see themselves and are seen by others as the men uniquely responsible for the pursuit of a set of shared goals, including the training of their successors," a counter centrifugal rhetorical force threatens the stability of the definition. Incompatibility does occur—though it is "rarer" than in, one might assume, less truthful fields. The idealized "full communication," similarly, is sometimes "arduous," resulting in an implied forgivable "misunderstanding." The centrifugal dialogic of this definition reaches its

highest intensity at the very end of the paragraph: infelicities of communication can result in "significant and previously unsuspected disagreement."

The tension in Kuhn's definition, I maintain, comes from his attempt to both "socialize" science while also denying its social nature. Instead, what is more apt is an inversion of Kuhn's definition, where "competition" is between "men"—and in the case of the "model" scientific community, white, upper-class men—and not the ideas themselves. In that light, communication becomes covertly rhetorical, with "significant and previously unsuspected disagreement" indicative not of a conceptual conflict, though that may be the site where power is overtly played out, but of a human conflict. In other words, competition between men for status is negotiated in part by displays of ostensible "scientific inquiry."

Using Kuhn's definition, one might assume that the most representative community of early Enlightenment scientists was the Royal Society. Indeed, Hooke, Boyle, Newton, Flamstead, Halley, Barrow, Oldenburg, and a host of others involved with the Royal Society are frequently treated by historians of science as the emerging model of scientific practitioners forming a community, as Margery Purver in The Royal Society: Concept and Creation maintains:

> That the activities of the Royal Society enormously accelerated the development of the natural sciences is generally accepted; but that this was the working out of a conscious, deliberately conceived ideal has been lost to sight, and with it, the real significance of the early Royal Society's contribution to science. Perhaps, paradoxically, it is some measure of the originators' success that what they had pioneered came to be taken for granted. Those succeeding generations for which the society had so

> tenaciously struggled to build a solid foundation for a new 'Systeme of Natural Philosophy' failed to see that strenuous action had ever been necessary, supposing that this undertaking was the unpremeditated, inevitable product of its age. (239)

Unlike Purver, who argues the Royal Society was the critical determinant in setting the stage for "the single most important turning-point in the story of man's relationship with his physical environment" (239), Kuhn makes no mention of the Royal Society in Structure of Scientific Revolutions. That omission is somewhat understandable, given that Kuhn's sense of scientific community refers more to a group of people who are drawn together by a commonly held paradigm rather than a group established through formal inclusion in an "official" institution. Conversely, Purver's general argument is almost at the other extreme. Modern science, for Purver, is the result of the Royal Society consciously going against ideas that were "antiquated, unrealistic and sterile" by acting on Francis Bacon's call for a new method and cutting "away the whole existing system of natural sciences, and deliberately [beginning] the process of creating new sciences in which an organized body of related inductive knowledge, capable of continuous, unlimited development" for "the long term benefit of mankind" (235).

Both, I maintain, are partially correct—Kuhn with his sense of "community" that underscores science as a social enterprise and Purver with her assertion of the prominence of the Royal Society in forming such a Kuhnian community. Yet both, I additionally maintain, are clearly blinded by an idealized view of the scientific enterprise. Kuhn would have us believe that objective truth wins the day, overwhelming psycho-social factors, though they are involved, and Purver would have us believe that the Royal Society policed successfully against the confounds of psycho-social factors, offsetting

"the failure of some Fellows [of the Royal Society] to grasp the basic principles of its scientific policy, and a degree of dilettantism" (238). Implicit in both is a sense that "disinterestedness," that is, freedom from human bias, is the primary stance of the scientist, who, to return to the concept of suprahumanization of science, somehow transcends the petty world of strivings for status and power, and sacrifices personal gain for the lofty goal of objective truth. In both, one almost gets a sense of two iterations of Lives of the Saints, with Kuhn's approach focusing in a very Protestant way on scientists being infused with the holy spirit of objectivity, and Purver's approach focusing on the "Father" church of the Royal Society. I am not being entirely glib with my religious comparison. According to Purver, the Royal Society was founded upon principles outlined by Francis Bacon, whose "vision of the new sciences was down to earth; the facts of nature were the subject of his study. Yet the impulse behind it was essentially a religious one, and the Royal Society, as a body, followed his precepts on religion in its relation to science" (143).

However, by Newton's time the situation, in terms of the relationship between religion and Natural Philosophy, was complex. Shapin, in The Scientific Revolution, argues for a more complicated relationship between early science and Christianity:

> […] the sense in which early modern changes in Natural Philosophy "threatened" religion or were animated by irreligious impulses needs to be carefully qualified or even denied. In speaking about the purposes of changing natural knowledge in the seventeenth century, it is obligatory to treat its uses in *supporting* and *extending* broadly religious aims.
>
> There was *no such thing* as a necessary seventeenth-century conflict between science and religion, but there were quite a few specific

> problems for the relations between the views of some natural philosophers and the interests of some religious institutions [Italics Shapin's]. (135-136)

On the one hand, as indicated earlier, and as I explore at length in Chapter Four, Newton's science and religion were inseparable, demonstrative of Shapin's sense of science "supporting" and "extending" theological agendas. In many ways, Newton superficially fits this mold of scientist as engaged in a religious enterprise. However, given his psychology, which, as I argue in detail in Chapter Three, drives him to express an Adlerian "will to superiority" through an agonal approach to scholarship with an end goal of verification of his high status, and his embracing of his specific heresy, what we have with Newton at the time of his first major interaction with the Royal Society is an individual predisposed to view all communities as both tending towards spiritual corruption and threats to his status. In retrospect, it would have been nice, as Brett says to Jake in The Sun Also Rises (Hemingway 251), if Newton's initial interaction with the Society was an example of both Kuhn's sense of suprahumans devoted to truth, exclusive of human peskiness, as well as an entity devoted to consistently upholding disinterestedness.

What happened to Newton, sadly, is almost the opposite. In January, 1671, after having given the Royal Society, at their request, what was the most advanced telescope of the era, Newton received a letter from James Oldenburg, a Society Fellow, requesting that Newton send a detailed description of the telescope, in large part to "provide some meanes to secure this invention from ye Usurption of forreiners" (73). As Westfall notes, Newton seemed flattered by the letter –"fairly beamed as the warm glow of praise fell upon him" (83), and responded to Oldenburg in the affirmative, adding somewhat cryptically at the end of the letter that he "would testify to [his] gratitude by

communicating what my poore and solitary endeavors can effect towards ye promoting your Philosophicall designes" (80). Newton's "poor and solitary endeavors," in this instance, referred to his work on light and the corpuscular theory, and in 1672, his account was published in the Royal Society's Philosophical Transactions. Robert Hooke, when the telescope is demonstrated at the Royal Society, dismisses Newton's device. Society Fellow John Collins, who was at the meeting, recounts Hooke's attack:

> Mr Hooke moreover affirmed *coram multis*[in the presence of many] that in the year 1664 he made a little tube of about an inch long, to put on his fob, which performs more than any telescope of 50 foot long made after the common manner; but the Plague happening, which caused his absence, and the fire, which demanded his employments about the City, he neglected to persecute the same, be unwilling the glass grinders should no anything of secret. (Qtd. in White 178).

Hooke's claim is extraordinary, given the nature of Newton's invention. What Newton had developed was a telescope that made use of concave mirrors rather than a set of convex lenses, allowing the instrument to avoid the distortion in light inherent in the older design. Significant here as well is Hooke's stated reason for not pursuing his own design: to keep secret the knowledge from what one imagines are "forrein" glass grinders. Despite the overt commitment of Royal Society Natural Philosophers to share knowledge and technology, in large part ostensibly so that experiments, observations, and other empirical demonstrations could be replicated, those in the know are a select group, not just of the same nationality but also of same class—the emergent "Royal" scientist. Most remarkable here is that Hooke's comment is a blatant lie, a nearly parodic moment of word of mouth reportage.

Hooke, apparently not content with belittling Newton's mechanical efforts, also accused Newton of the greatest transgression of an Enlightenment scientist: the feigning of hypotheses. At issue was the nature of light, with Newton adhering to the corpuscular or particle theory, and Hooke to the wave theory. Newton's work with prisms that lead to his presentation before Hooke and the rest of the Society seemed to indicate that light was composed of particles. Specifically, Newton claimed in his 6 February 1672 letter to Oldenburg that he did not "mingle conjectures with certainties," that "it can no longer be disputed whether light be a body" (100), directly affirming that his experiments had proven Newton's corpuscular theory, and by extension, disproved Hooke's favored wave theory. Hooke's response to Newton's ideas, sent to Oldenburg less than two weeks later, is unequivocally disdainful: "I cannot yet see any undeniable argument to convince me of the certainty thereof. For all the expts & obs: I have hitherto made, nay, even those very experiments which he *alleged* to do seem to me to prove that light is nothing but a pulse or a motion propagated through… a uniform or transparent medium" [italics added] (110). That "alleged" is no innocent term: Hooke is stating not only that he has counter empirical evidence, which by itself is just what we would expect a true scientist would use as proof, he also is implying Newton did not even conduct the experiments, an attack not on theory or on method, but on character.

In June of 1672, Newton responded to Oldenburg, answering Hooke's *Considerations*, the outline of his critique of Newton's light studies published in the Transactions. Newton writes:

> But I must confess at ye first receipt of those *Considerations*, I was a little troubled to find a person so much concerned for an Hypothesis, from whom in particular I most expected an unconcerned and indifferent

> examinations of what I propounded... But yet I doubt not but we have one common design, a sincere endeavor after knowledge, without valuing uncertain speculations for their subtleties, or despising certainties for their plainness. . . . Mr. Hook thinks himselfe concerned to reprehend me for laying aside the thoughts of improving Optiques by refractions. But he knows well ye it is not for one man to prescribe Rules to ye studies of another, especially not without understanding the grounds on wch he proceeds. Had he obliged me by private letter on this occasion, I would have acquainted him with my success in the tryalls that I have made of that kind. (171-172)

What emerges in this "public" interchange is far less a model of gentlemanly scientists objectively discussing findings and methods than it is an example of an "institutionalized" moment of a more powerful member of a community retaliating against a potential contender for power, using in particular the idea of "disinterestedness" in a most self-interested way. A number of issues emerge here, not the least of which is the issue of public and private. Letters between Society members, though ostensibly private, frequently form the basis for presentations read to the Society, and then are translated into proceedings in the Transactions. Additionally, the letters allow for an interesting handling of discourse: though the entire text of Newton's June 11 letter is a point-by-point response to Hooke's criticisms, it is sent to Oldenberg, and forms the basis for yet another presentation at the Society, as well as another publication in Transactions. This use of a third party characterizes many of Newton's letters, especially when they involve direct rivals such as Hooke and much later, Leibniz, and works as a kind of deflection of the real target. An early example is the letter quoted

above, where Newton, Westfall writes, not only outlines a "brilliant" argument concerning analysis versus modification, he also presents

> an *argumentum ad hominem*. Far from omitting Hooke's name, Newton inserted it into the first sentence of the reply, in the last, and in more than twenty-five [27, by my count] others in between. He virtually composed a refrain on the name Hooke. Successive drafts of various passages passed through three or four stages, each one more offensive than the last. (92)

For Westfall, this exchange is undeniably agonal. Westfall's martial metaphor as he continues is more telling than he knows:

> [Newton] employed the broadsword instead of the rapier. Where Hooke's observations had been irritatingly patronizing, Newton's reply was viciously insulting. – a paper filled with hatred and rage. The Royal Society forebear to print Hooke's critique lest it appear disrespectful to Newton. It did allow for Hooke to endure the humiliation, first of hearing the response read at a meeting, then of seeing it in print in *Philosophical Transactions*. (93)

What is especially interesting about Westfall's presentation of this incident is a consistent framing of the incident as an understandable tit-for-tat episode that fails to highlight that Newton, by Westfall's own analysis, soundly trounces Hooke—his elder and a powerful member of the Royal Society. Implicit in Westfall's precise accounting is an overlay of justification for Newton's rhetorical attacks: Newton ends up correct about light, ergo, the human squabble, always outside of real science, appears as a quirk rather than a significant factor in Newton's discourse. The hidden move is a view of science working its way to truth through two men who happen to be squabbling rather than two men, both

conscious of rank and status, using "science" to manipulate those ranks. In this instance, the social fact is that Newton both is protected by the Society and has Hooke punished. The fact that Hooke loses status—endures public "humiliation"—comes off in Westfall as an inevitable consequence of backing the wrong idea, rather than having been outclassed by an upstart. Newton's expertise in idea construction invites that easy analysis, and certainly principles of science can be applied outside of such an agonal field. But it is that very outside-the-human-ness of science that especially invites a misappropriation of the authority of science to neglect or do social violence to the human.

Despite Newton's success with Hooke—both in refuting Hooke's science and in socially wounding him—he threatened to resign from the Society in 1673. Newton writes to Oldenburg in March:

> Sr I desire that you will procure that I may be put out from being any longer fellow of ye R. Society. For though I honor that body, yet since I see I shall neither profit them, nor (by reason of this distance) can partake of the advantage of their Assemblies, I desire to withdraw. If you please to do me this favour you will oblige
>
> Your humble servant
>
> I Newton. (262)

Both of Newton's reasons for withdrawing are typical of his frequent self-deprecating rhetoric that masks an angry superiority. Both, as well, are ironic. Newton's continued engagement via letters with the Society after the Hooke episode, primarily through ostensibly "private" correspondence with third party Oldenburg, suggests he very much thought he had something to offer the Society. Relatedly, from the outset Newton hasn't really taken advantage of the physical assembly, the public meetings. His approach

throughout has been to act behind the scenes via the letters, letting the letters alone create his ethos, rather than manipulating directly as Hooke did. However, the continued criticisms of Newton's ideas, from Society Fellows such as Christian Huygens, John Collins, John Gregory and others, Newton seems to treat more and more as personal affronts, though none beyond Hooke display anything but admiration, honest questions, and requests for clarification. Newton writes to Collins in May, 1673:

> Concerning the expenses of being a member of ye R.S. I suppose there hath been done me no unkindness, for I met wth nothing in yt kind besides my expectations. But I could wish I had met with no rudeness in some other things. And therefore I hope you will not think it strange if to prevent accidents of that nature for ye future I decline that conversation wch hath occasioned what is past. I hope this, whatever it may make me appear to others, yet will not diminish your Friendship to me. (282)

In early June 1673, Oldenburg, seeming to think Newton's withdrawal from the Society has to do with annual fees, offers payment of membership fees, along with apparently permanent waiver of such fees in the future. Additionally, note his almost pleading tone as he attempts to explain how the Royal Society really feels about Newton:

> And I could heartily wish, you would pass by such incongruities, yet may have been committed by one or the other of the Body towards you, and consider, that hardly any company will be found in the world, in whc there is not some or other yt wants discretion. You may be satisfied, that the Body in general terms esteems and loves you, wch I can assure you of, *fide viri bondi*, who am with all integrity
>
> Sir

> Your humble and faithful servt. (284)

In June 1673, Newton writes to Oldenburg an even stronger declaration of withdrawal, this time not only from the Society but from the very field of Natural Philosophy:

> But I must, as formerly, signify to you, yt I intend to be no further sollicitouus about matters of Philosophy. And therefore I hope you will not take it ill if you find me ever refusing doing anything more in yt kind, or rather yt you will favor me in my determination by preventing so far as you can conveniently any objections or other philosophical letters that may concern me. (294-295).

Westfall maintains Newton's gradual neglect of interactions with other scientists following this exchange was mainly due to his being "absorbed in theology and alchemy" and therefore "distracted by correspondence and criticism on optics and mathematics"(133). White, interestingly, discusses Newton's "silence" as the time when the ideas for the Principia began to come together:

> It was the beginning of a long period of isolation. Despite several attempts to draw him from self-imposed isolation, Newton maintained a brooding silence. Within the isolation of the laboratory at Trinity, the theoretical ideas that were to coalesce in the *Principia* were coming together. Newton believed he could not develop his intellectual masterpiece under the gaze of an unsympathetic scientific community—one whose members were so far behind him they could not even grasp his methods. (188-189)

Both Westfall and White seem driven to provide a rich yet essentially romantic view of the isolated genius scientist, with White's analysis hinting at but not fully exploring, much less using a primary determinant, Newton's perception of himself in relation to

other people, justified by and continually elaborated, through his studies in alchemy, Natural Philosophy, and Theology. Both have a handle on the facts of the situation at this time: Newton is, as Westfall notes, deeply involved with alchemy and theology, and the Principia's ideas, as White indicates, do seem to be traceable to the period roughly between 1674 and 1684. However, more is involved here than avoidance of "an unsympathetic scientific community." Newton is demanding not equal treatment but something akin to adoration. Simply, putting aside the objective truth of Hooke's and Newton's respective scientific claims, both of which are correct, that is, capable of experimental demonstration (as I discuss in Chapter Five). Newton's texts are also serious attempts at manipulating social power by deploying truths derived from the nascent science to damage a fellow "disinterested" observer's social status, as Hooke's recorded humiliation reflects.

Despite Newton's increasing "self-imposed isolation" following the Hooke incident, he continued to maintain correspondence with a number of Society Fellows, including Oldenburg, Collins, and Hooke himself. In 1679, Hooke writes Newton in a blatant attempt to draw him out:

> Sr
>
> Finding by our Registers that you were pleased to correspond with Mr Oldenburg and having also had the happinesse of receiving some Letters from you my self make me presume to trouble you with this present scribble. Dr Grews more urgent occasions having made him Decline the holding Correspondence. And the Society, hath devolved it on me. I hope therefore that you will please to continue your former favors to the Society by communicating what shall occur to you that is Philosophicall, and in

> returne I shall be sure to acquaint you wth what we shall Receive considerable from other parts or find out new here. And you may be assured that whatever shall be soe communicated shall be noe otherwise farther imparted or disposed of then you yourself shall prescribe. I am not ignorant that both heretofore and not long since also there have been some who have indeavourd to misrepresent me to you and possibly they or others have not been wanting to doe the like to me, but Difference in opinion if such there be (especially in Philosophicall matters where Interest hath little concern me thinks shoud not be the occasion of Enmity—tis not with me I am sure. For my own part I should take it as a great favor if you would please to communicate by Letter your objections against any hypothesis or opinion of mine. . . .(297)

Hooke's rhetoric here is compelling. First, he claims he represents the society, not himself, and is only writing because the official Secretary, Grews, was too busy. Secondly, Hooke seems to offer a fair exchange of findings from others, and promises that this time the correspondence will be kept private until Newton himself requests public dissemination. Finally, Hooke invokes the ideal of disinterestedness, claiming that the problems Newton had with him in the past were due to misrepresentation. Overtly, the goal of persuasion here seems to be let bygones be bygones, we disinterested scientists have work to do, and opinion, status, bias, and other violations of objectivity have nothing to do with this enterprise. The specific Natural Philosophical issues about which Hooke inquires following this lengthy introduction are Newton's ideas about planetary motion, specifically about earth's diurnal (daily rotation on its axis) rotation.

Newton's response is typical, both in nearly parodic self-deprecations and in positioning himself as only interested in disinterested pursuit of knowledge:

> Sr
>
> I cannot but acknowledge myself every way by the kindness of your letter to concur with your desires in a Philosophical correspondence….yt I have had no time to entertain Philosophical meditations or so much as study or mind anything but Countrey affairs. And before that, I had for some years past been endeavoring to bend myself from Philosophy to other studies in so much yt I have long grutched the time spent in yt study unless it be perhaps at idle hours sometimes for a diversion: which makes me almost wholly unacquainted wth what Philosophers at London or abroad have of late been imployed about…. And thus having shook hands of Philosophy, & being also at present taken wth other business, I hope it will not be interpreted out of any unkindness to you or ye Society that I am backwards in engaging myself in these matters, though formerly I must acknowledge I was moved by other reasons, to decline as much as Mr Oldenburg's importunity & ways to engage me in disputes would permit, all correspondence with him about them. (300-301)

Note Newton's ostensible reasons for not "engaging" philosophy: he is out of touch with the community of scientists, he is busy with "country affairs," and he is involved studying other matters. The first reason Newton proves unsupportable when he reveals later in the letter that he is, at least, aware of Hooke's recent work on celestial motion. The second reason, "country affairs," is laughable on the face of it: Newton has little to do with managing his mother's estate, and spends the bulk of his time in his quarters at

Trinity College. Only the last reason—"other studies," work in both alchemy and theology—is defensible from the historical record, though his work with both those fields is not to the exclusion of Natural Philosophy. More significantly, following this list of "reasons," Newton then proceeds to answer Hooke's specific questions, which concern the earth's diurnal motion.

Unfortunately, Newton made a serious mistake in the mathematics supporting his argument. As White notes, Hooke's behavior after discovering the error suggests anything but the disinterested scientist kindly but firmly assisting a peer in the pursuit of knowledge. After discovering the mathematical error, White writes, Hooke breaks his promise of confidentiality and

> immediately and gleefully read aloud Newton's work at the next meeting of the Royal Society…. By publicly parading this error, Hooke had not only broken Newton's trust but had deliberately tried to damage his reputation in the eyes of his scientific colleagues. Worse still, Hooke's calculation had been based upon nothing but a lucky guess. (White 196-197)

Again, White's own contextualization of the incident makes Newton entirely the victim, and invites a view of Newton's more rhetorical moments, such as when he claims to be ignorant of others' work in Natural Philosophy when he has kept abreast, as merely defensive tactics. However, in 1675, after the initial confrontation over the telescope and theory of light, Hooke wrote to Newton after hearing Newton's earlier letter to Oldenburg expressing "An Hypothesis explaining the Properties of Light Discoursed of in Several of my Papers" (362-394) presented at the Society. Newton's paper specifically attacked

Hooke's wave theory. Hooke's response to Newton's successful efforts in demonstrating Hooke's own errors seem less brutal than Newton's responses to his attacks:

> The Hearing of a letter of yours read last week in ye meeting of ye Royal Society made me suspect yt you might have been some way or other misinformed concerning me…. I do justly value your excellent Disquisitions and am extremely well pleased to see those notions promoted and improved upon which I long since began, but had not time to compleat. That I judge you cannot meet with any subject more worthy of your contemplation, so I believe the subject cannot meet with a fitter and more able person to inquire into it than yourself, who are every way accomplished to compleat, rectify and reform what were the sentiments of my younger studies[…].(412)

The worst one can say of Hooke's response, beyond the gratingly obsequious tone throughout, is that "sentiments of my younger studies" stretches the meaning of both "sentiment" and "younger." Hooke had been arguing strenuously for his theory of light as a demonstrable hypothesis right up to the time of Newton's critique, suggesting at the minimum a very strongly held "sentiment." Additionally, Hooke's 1665 paper "Micrographia," to which Newton addressed the critique, was only a decade old, technically published during Hooke's "younger" period, but not superceded by anything the "older" Hooke produced.

Newton's response to Hooke's effusiveness suggests the author is something more than a victim, as it contains a sentence, White notes, that "has been quoted so often yet has been largely misunderstood for over three centuries" (187):

> Sr

> At reading your letter I was exceedingly well pleased & satisfied with your generous freedom, & think you have done what becomes a true Philosophical spirit. There is nothing which I desire to avoyde in matters of Philosophy more then contention, nor any kind of contention more than one in print…. And if there is anything else in my papers which you apprehend I have assumed too much, or nor done you right, if you please to reserve your sentiments of it in a private letter, I hope that you will find that I am not so much in love with philosophical productions but yt can make them yield to equity and friendship. But, in ye meane time you defer too much to my ability for searching into this subject. What Des-Cartes did was a good step. You have added much in several ways…. *If I have seen further it is by standing on ye shoulders of Giants* [Italics added]. (416)

Again, as with Hooke, at the overt level, this letter seems a professed desire for peace, an offer of a friendly relationship, and a self-effacing admission of the historical and community dimensions of "philosophical production." Indeed, this letter has been often deployed to present a view of a humble Newton, the model scientist who seeks no glory for himself but only to add to the work of those—such as Hooke—who have done the giant's share of effort. White, however, interprets the quote differently:

> In that last sentence Newton revealed the truly spiteful, uncompromising and razor-sharp viciousness of his character, for Hooke, once described as "crooked" and "pale-faced," was so stooped and physically deformed that he had the appearance of a dwarf. The phrase "standing on ye shoulders of Giants" was a perfectly double-edged comment, designed deliberately to

> mislead. On the surface, it appears a compliment—Hooke is called a giant—but Newton meant quite the reverse. (White 187-188)

White's strong descriptors—"truly spiteful, uncompromising and razor-sharp viciousness"—hide the assumptions lurking around the term "character." Rather than beg the question "how can such a smart man be so mean? it seems better to ask, "what framework makes logical a consistency between the smartness and meanness?" The answer, I maintain, to that question lies in Newton's "perfectly double-edged" manner of commenting. Newton's entire system of systems is suggested in this commentary. First, Newton's hiding of the edge that cuts demonstrates his commitment to what I call *crypticity* that is, a discourse strategy characterized by a marked degree of indecipherability with a simultaneous avowal of self-evident clarity. In this instance, he hides his theologically based belief in a radically hierarchical society, where a sharp vertical continuum exists, from base to pure. The inverted allusion to Hooke's stature and "ugliness" are both figurative of the continuum as well as a literal instance. The base looking man is closer to the base; and "to stand on" is also to stand over, in violent domination. The inversion, significantly, doesn't only hide the very interested agenda: it overtly proclaims the opposite. Related to *crypticity* is a belief in radical *Oneness*, of which Newton's official belief in "Unity of Matter," (Dobbs and Jacob) reinforced by both the science and the alchemy, is not so much the principle itself than an example of *Oneness*' elaboration in the book of nature. That *Oneness*, significantly, doesn't just operate at the conceptual level, where there can be only one demonstrable hypothesis, such as undulating vs. particulate light, but at the social level, where for Newton there can be only one lord of light, so to speak. That belief in *Oneness*, in turn, reflects Newton's commitment to *purification*, which is a trend towards radical reductionism, at

the conceptual level of his science, and radical policing, at the social level. In the following section, I position Newton' s Principia as a response to what Newton sees as the competitive, hierarchicalized community of scientists, covertly drawing the real authority for the text from a hidden God the Father while overtly appealing to the ethos of objectivity. As are Newton's letters to Hooke, the Principia is characterized by *crypticity*, is founded on an assumption of *Oneness*, and employs a systematized method of *purification.*

Constructing Community II: Principia Mathematica Theologia

Following Newton's 1679 humiliation by Hooke's communal exposure of Newton's mathematical error in calculating diurnal rotation, he entered what many historians consider the most isolated period of his life as a scientist (Westfall 133; White 188-189). Not until 1684 did he attempt another major presentation for the Royal Society, this time at Edmund Halley's urging (Westfall 159-160). Samuel Pepys, having replaced Hooke as the Society's Secretary, seemed more receptive to the work, and Newton began serious study of what would become the groundwork for the Principia. The paper that resulted was *De Motu Corporum in Gyrum* (*On the Motion of Revolving Bodies*). Hooke's more serious accusation—that Newton feigned hypotheses—obsessed Newton in the development of the Principia, and, by extension, his method of doing science. He "reluctantly" submitted *De Motu* to the Society, and only after Halley's repeated requests (White 211). In 1686, he had published the first edition of what could be called the bible of science.

Newton's most celebrated work in Natural Philosophy is his Philosophia Naturalis Principia Mathematica. Boyer, in A History of Mathematics, calls it "the most admired

scientific treatise of all time" (398). Berlinski, in Newton's Gift: How Sir Isaac Newton Unlocked the System of the World, is even more effusive:

> Newton's masterpiece is […] the Principia[…]. Nothing like the Principia had ever appeared before the seventeenth century; and in truth, nothing like the Principia has ever appeared afterwards. In very large measure, it was the Principia that ignited the furious dark energies that brought mathematical physics into existence and that have sustained its fires for more than three hundred years.(xiii-xiv)

In truth, one can open almost any book on Newton, general science, or history of science and find this nearly religious adoration of Newton's text. However, this "masterpiece," Albert Einstein notes, is "as austere and forbidding to the nonspecialist as it can possibly be" ("Preface" to Opticks xviii). For Einstein, the book's difficulty is due to several factors, including the Principia's "avoidance of speculation,"("Preface" to Opticks xxxiii), its "archaic mathematical language,"("Preface" to *Opticks* xviii-xix) and its initial publication in Latin ("Preface" to Opticks xxi). The title itself betrays its nearly audacious intent: to provide a method of reading the natural world that results in truthful statements about its structure, functions, and properties. In this work, Newton provides three books: the first concerns problems of motion that involve no friction or resistance; the second addresses friction's effect on the motion of solid bodies in fluids, and the last, which with the even more audacious title of "System of the World," brings together Kepler's laws, mathematical representation, and structured observation. The common notion of this book is that it is the work of a more or less isolated genius, written in order to present a coherent picture of the natural world and a systematic way of uncovering the laws of that natural world. However, given the social factors in play leading up to the

Principia's development as demonstrated in the prior rhetorical analysis of Newton's exchanges with Hooke, my argument is that that notion is more aptly descriptive of the "community of scientists'" reception of the Principia in the eighteenth, nineteenth, and early twentieth centuries than of its actual emergence in the seventeenth century. The book certainly lends itself on the surface to the traditional description above: Newton was arguably isolated during the work's later stages; it does present a powerful account of nature using a prescribed set of empirical approaches; and it outlines, for the first time ever, laws of motion that can be both mathematically represented and experimentally demonstrated.

Inarguably, following its first publication in 1684, the book met with immediate acclaim. Expectedly, considering the role he played in expediting its publication, when the book is first published, Halley gives it a very positive though anonymous review in the Royal Society's *Transactions* (White 223). Additionally, Halley's "Ode on This Splendid Ornament of Our Time and Our Nation, the Mathematico-Physical Treatise by the Eminent Isaac Newton," which appeared at the very beginning of the Principia, more lyrically conveys his praise:

> O you who rejoice in feeding on the nectar of the gods in heaven,
> Join me in singing the praises of NEWTON, who reveals all this,
> Who opens the treasure chest of hidden truth,
> Newton, dear to the muses,
> The one in whose pure heart Phoebus Apollo dwells and whose mind he has filled
> With all his divine power,
> No closer to the gods can any mortal rise. (Halley Principia 380)

Halley's positioning of Newton as "closest" to God for his Natural Philosophic efforts is remarkable on a number of levels. First, it presents, however accidentally, what I argue throughout this dissertation: Newton's efforts in all fields of study involved making him "closer to God," with the critical corollary that other "mortals" cannot rise "closer to the gods." Secondly, Halley's sanctification of Newton for the Principia, perplexing when one considers Halley's private admission that he could not understand most of the book, dramatically underscores Newton's success in achieving high status in large part via construction of a system of knowledge that maintains sharp vertical social hierarchies through deployment of language which deliberately and covertly excludes readers, while just as deliberately but overtly maintains any sense of exclusion is the fault of the lower-status reader. Newton's book's unintelligibility takes on almost legendary status at Trinity; an oft-told tale is of one undergraduate at the college remarking to another as they see Sir Isaac walk by is that there goes "the man that writt a book that neither he nor anybody else understands" (Qtd. in Christianson 83).

White is the most forthcoming about not only the book's difficulty but also Newton's intentional unreadability:

> Present day scientists are keen to express their work to the layperson, if for no other reason that to popularize their subject in an effort to increase funding. Newton took the very opposite stance: He wrote the Principia in classical Latin and suppressed publication in English until the final year of his life. Furthermore the Principia was composed in the form of propositions which followed one from the other, so that the previous proposition had to be understood before tackling the next—it was not a book to dip into. (216)

White's description of the book is accurate, as is his argument that Newton intentionally wrote it to be inaccessible. However, his explanation—that Newton "was tired of unqualified individuals questioning his great pronouncements" (216)—is only part of the story. Ironically, Halley's poem's last line—"No closer to the gods can any mortal rise"—accidentally reveals Newton's theological justification. In Newton's system, social, philosophical, and spiritual rank orders are parallel: Newton's *crypticity* in the Principia, in short, gives him unquestioned status as the lord of science, while preventing not only understanding of the scientific principles but also recognition of the Puritan heresy that gives the entire approach theological authority.

By "looking crookedly," as Cheyl Glenn describes her method of historicizing, at Newton's rhetorical strategies, Newton's Principia's ostensible unintelligibility emerges as an other-ordered intelligibility, in which the work's difficulty serves the purpose of allowing Newton's ideas not only dissemination but eventual adulation, while also preventing its use as evidence of either heresy or occultism and creating an even more radical hierarchy than the old aristocracy or the emerging wealth-based stratification. Only Newton, in the end, can fully understand Newton. Newton's *crypticity* is a passive form of policing, in that it cordons off readers, and sets up a radical stratification based not upon blue blood or overt material markers such as wealth but upon how well one can interpret the world and the interpretations of the world—of which the Principia stands, in this system I am arguing underlies Newton's efforts, as the primary exemplar. To support this admittedly extraordinary claim, I first examine Newton's discourse for evidence of *crypticity*. Following that, I position Newton's "Rules of Reasoning" as an outline of a system of *purification*. Finally, I approach the "General Scholium" in thePrincipia as evidence of both Newton's belief in theological authority driving the enterprise of science

and of his attempt to mask that theological authorization, both of which are indicative of his conceptual, psychological, and social commitment(s) to *Oneness.*

Crypticity

Newton's commentary on his level of discourse in the "Scholium of Book Three" in the Principia is revealing:

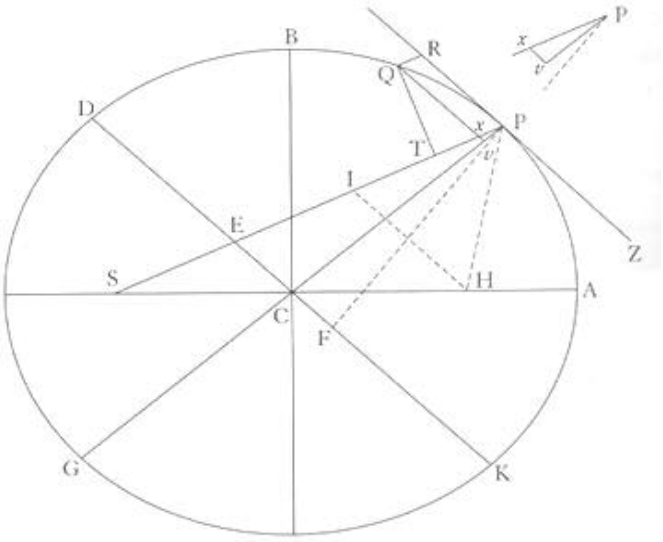
> On this subject [Natural Philosophy] I composed an earlier version of book 3 in popular form, so that it might be more widely read. But those who have not sufficiently grasped the principles set down here will certainly not perceive the force of the conclusions, nor will they lay aside the preconceptions to which they have become accustomed over many years; and therefore, to avoid lengthy disputations, I have translated the substance of the earlier versions into propositions in a mathematical style, so that they may be read only by those who have first mastered the principles. (793)

In this passage, Newton is addressing directly the particular problem of audience for his work. His mention of an earlier "popular" account, which a number of Newton scholars maintain was never written, suggests several rhetorical ends sought. On the surface, Newton by indicating a preference for a popular account seems to be building an ethos of egalitarianism. However, this egalitarianism is suspect from the start: he is really writing to the Royal Society, and RS wannabes. Halley and others are pushing him to publish within a particular rhetorical field composed of upper class white males—the scientific gentry in many ways—with access to education, leisure time, and essentially "servants." Markley, in "Boyle Epitomiz'd" in Fallen Languages, argues persuasively that Boyle's description of the building of an air pump that requires the employment of a veritable

army of servants—"Mechanick People," in Boyle's words—to conduct the dirty work of constructing and setting up the apparatus to allow the elite, "class-specific" occupation of seventeenth century scientist to work. The short of it is that Newton's audience from the outset is anything but "popular" in any real egalitarian sense, and is more on the level of equal-among-superiors. Newton's statements following his rhetoric about really meaning to make the text accessible but discovering that it is not the writing but the subject matter itself that makes the material inamenable to clear accounting reveals his overall strategy of wanting to appear a mere conduit of knowledge while really—and covertly—creating a rigidly stratified society of readers-of-the world. The truly literate in this system "grasp the principles" and have "perceived the force of [Newton's] conclusions," and have given up "the preconceptions to which they have become accustomed over many years." In short, they have been persuaded—and not only of Newton's conclusions but of his method itself, and not only of his conclusions and general method, but most importantly, of Newton's "superiority-among-superiors" in "translating" specifically, the gist of his work into "mathematical propositions" that an audience who has "mastered" Newton's principles can finally grasp. However, a higher-order translation is at work here: Newton is translating the text of the world via general principles of reading and then is translating those translations into yet another text, one that is finally "accessible"—to the masterful elite. Accessible, in actual reception, to the extent that Sir Isaac is famous for having "writt the book no one understands."

To get a feel of Newton's *crypticity* at the sentence level in the Principia, I offer the following quote from "Book One, Part Three." In this section he is describing how to

find the law "of the centripetal force tending to the focus of the ellipsis:"



> Let S be the focus of the ellipsis… Drop QT perpendicular to SP, and if L denotes the *princi al lartus rectum* of the ellipsis (or for $2BC^2/AC$), we shall have L x QR to L x P*v* as QR to P*v*, that is, as PE or AC to PC; and L x P*v* will be to G*v* x P as L to G*v*; and G*v* x *v*P will be to Qv^2 as PC^2 to CD^2; and by (Lem. VII, Corol. 2,) the points Q and P coinciding, Qv^2 is to Qx2 in the ratio of equality; and Qx^2 or Qv^2 is to QT^2 as EP^2 to PF^2, that is, as CA^2 to PF^2, or (by Lem. XII) as CD^2 to CB^2. (Newton Principia 462-463)

This quote and its preceding figure exhibit a number of provocative characteristics, which, taken together, reinforce the concept of *crypticity*. Newton is pressed not just to make his case for this particular principle, but for his whole authority in writing the world in such a way. One way in which he forces his authority is via the use of the imperative—"Let S be…." The imperative mode is a commonplace in "scientific" writing, dating back to the emergence of mathematical reasoning in early Greek discourse. It is strongly associated with certain forms of what James Kinneavy, in A Theory of Discourse, calls

"reference" discourse, as distinguished from "expressive," "literary," or "persuasive" discourses. For Kinneavy, although reference discourse is a broad category, "the assertions must be referential. This means the main concern for the discourse must be the reality under consideration…. Therefore… the reader as a target of persuasion, emotional or otherwise, intrudes only indirectly and implicitly" (88). However, even though this quote is not only a sample but also an early model of reference discourse, which ranges from scientific treatises to technical writing, it complicates Kinneavy's system of classification. The imperative mode alone is rhetorical: it slips what Aristotle in On Rhetoric calls the appeal to ethos from the speaker to the text itself, and literally authorizes the writer as one in command, as it is the mode of decree. Secondly, notice the use of the first person plural: "we have…." This choice of first person plural, also a commonplace in "scientific" discourse, has the rhetorical function, after acceptance of the author's decree by the audience, of making of the reader and writer together the "reliable witnesses" to the truth of what is stated. Not insignificantly, it collapses the "I" of first person narration, certainly a marker of "word of mouth" reportage, into a kind of collective word of mouth—into shared, consensual validation of what constitutes the real. Only this move is purely rhetorical: The ostensible adherence to the Royal Society's motto of "not by word of mouth" is a construct dependent upon the reader's acceptance of both the imperative mode's authorization, and the invitation to participate offered by the collective first person plural. Additionally, the overtones of royalty invoked by the "we" invites another layer of persuasion, in which the community of reliable witnesses take on the status of the Queen or King, suggesting an interesting displacement of blue blood aristocracy with literate blood "scientists," which parallels the early and mid-enlightenment's political move of supplanting the older hierarchy with a newer hierarchy.

What is retained is the power of privilege; what is changed is the source of that privilege, with the shift in pedigree-ization from a family tree of notables, to an academic VITA, in which one's blood is a blue as the ink upon the university diploma's parchment.

The imperative mode and the first person plural were commonplaces in scientific discourse, especially of the early Enlightenment. Where Newton's quote goes beyond these commonplaces is in its astounding difficulty in decipherability, its *crypticity*, in the language of this dissertation. First, the sentence is long; if each taken point or point(s) transformation (for example "Q," "C," and transformations such as "Qv^2" are taken as "worded" morphemes, this sentence runs over 100 words. Length in itself is trivial: what is complex to the point of dizziness here is the compounded ideas Newton is requiring the reader, the truly "literate" reader-of-the-natural-world, to both understand and accept the new relationships, all towards the larger goal of persuading said reader of the truth of the statement, especially in the larger sense of being part of the argument that is the whole of the Principia. Note, for example, the latter two parenthetical inserts in this "sentence:" the first requires the reader to have read, understood, and accepted "all parallelograms circumscribed about any conjugate diameters of a given ellipsis or hyperbola are equal among themselves," (436) as well as its second corollary—"all parallelograms described about any conjugate diameters of a given ellipse or hyperbola are equal to one another—" (458) in order to follow the mathematical argument. I am not taking issue with the "truth" of Newton's sentence, nor am I taking issue with the larger tradition of geometrical and/or mathematical reasoning. I am enough of a Platonist to entertain the idea that there may be something like forms transcendent of time, place, person—physical constants more or less "outside" of culture (see Chapter five for a redaction of Gödel's "Platonist" mathematics). Nevertheless, Newton is taking such reasoning to new heights, where an

overt commitment to disinterested observation, conceptually coupled to the Enlightenment discourse ideal of "perspicuity," hides a covert agenda, which is interested and which is deliberately unperspicuitousness. Newton's complex manner of expression makes even Swift's satire of such language appear a reasonable alternative:

> Let A B represent a line drawn cross the dominions of Balnibarbi: let the line cd represent the load-stone, of which let d be the repelling end, and c the attracting end, the island being over C; let the stone be placed in the position cd with its repelling end downwards: then the island will be driven upwards obliquely towards D. When it is arrived at D let the stone be turned upon its axel until its attracting end points towards E and then the island will be carried obliquely towards E; where, if the stone be again turned upon its axel until it stands in the position EF, with its repelling point downwards, the island will rise obliquely towards F, where, by attracting the attracting end towards G, the island may be carried to G, and from G to H, by turning the stone so as to make its repelling extremity point directly downwards. (203)

Additionally, the quote above's rhetoric, when juxtaposed with other sentences more overtly rhetorical (i.e., "persuasive" in even Kinneavy's classification), emerges as even more effectively rhetorical as it denies its rhetoricity. Consider the following from the "Scholium of Proposition II, Theorem III:"

> Since the uniform description of areas indicates that a centre towards which that force is directed by which a body is most affected and by which it is drawn away from rectilinear motion and retake its orbit; why should we not in what follows use the uniform description of areas as a criterion

> for a centre about which all orbital motion takes place in free spaces? (Newton Principia 449)

Why not, indeed? Again, here is the deployment of the first person plural, innocently asking for leave to accept a certain logical relation—that there is such a thing as a "centre," about which stuff circles. The seeming innocence of this statement is exacerbated by the use of a classic if extra deferential rhetorical question. In this instance of brazen deployment of a rhetorical strategy, Newton reveals his hand: what is at issue is gravity, especially Newton's alchemical notion of "action-at-a-distance." To accept both concepts, at least to the extent of allowing for a mathematical, theoretical, and direct observational synthesis which lends itself to such concepts' acceptance by the society, one must—we must, to use Newton's first person plural with its overtones of Aristocracy—first accept the concept of centre, which is something that exists not as a positive element but as a nexus of relationships—real only to the extent that it fits within a system of the world such as Newton's.

The reality of the centre of a body is no small thing for an Early Enlightenment scientist. First, Cartesian mechanics have allowed the removal of Scholastic "purpose" from things in large part by shifting conceptualization from depth to surface. The interaction of bodies in space, from a classical Cartesian frame, assumes a measurable medium for transference of cause and effect. Crudely, one body acts on another by somehow transferring energy via the aether. Newton's system all but denies the existence of the aether, and replaces that concrete form of causality with "action-at-a-distance." By itself, action-at-a-distance does not explain as much as describe bodies in motion. The concept of "centre," however, lets Newton use the mathematics of surfaces to authorize a kind of depth, while methodologically adhering to the opposition to Scholastic purpose.

That authorization of depth via "depthless" geometry allows Newton to introduce the concept of forces, including inertial, centrifugal, and centripetal, without direct appeal to God.

Leaving the issues of the centre aside, the complexity that emerges out of Newton's sentences would be perhaps momentary aberrations, cases of the scientist just not yet finding the most perspicuitous manner of expression, or could be just moments in which that which is signified is so complicated even the clearest of statements, as nearly "perfect" medium of transparent transfer of information, will read as incomprehensible, even to the most literate of readers, in Newton's instance, his Royal Society chums. However, the same general pattern of requiring a reader to understand each step of the argument fully before moving on to the next, and each step a world of a complex collusion of claims, drawn obviously from the semiotic universe of Natural Philosophy, but also as I am arguing, from alchemy and Arian Theology, is repeated in the overall design of the three books. The last book, beginning with the "Rules of Reasoning," and ending with the "General Scholium," to be fully understood requires full, step-by-agonizing-step acceptance of the persuasion via incremental acceptance of each element. On the surface, this slow and careful building of an unassailable argument seems the ideal of rationalism, at least of logical positivism. However, when the central claims, the larger premises upon which the elaborate chain of logic is dependent, are drawn from a very different view of reality, then the reader is ultimately left relying on faith—and not her own, but Newton's. In short, Newton's Principia requires very sophisticated (if not sophistical) hermeneutics; in the instance above involving the slippery centre, the argument both depends upon and is a step in a larger argument proving the concept of

action-at-a-distance, which requires belief not just in occult force but in a world which is designed in such a way as occult forces explain stuff.

Again, all of the above features of Newton's text—the neglect of a "popular" account, the complex building of a primarily analytic argument, and even the rhetorical question assuming the concept of action-at-a-distance—could be framed as merely conservative responses to Hooke et al.'s demands for scientific rigor. Additionally, Newton is writing at the beginning of modern science, where not only methods and findings but also modes of written communication were undergoing development. However, given Newton's repeated claims that he is trying to communicate as persuasively as possible the "truth" of his statements, then one would assume that, given requests for clarification—in the language of this paper, given opportunities to help make his peers' scientific literacy approach his own level—Newton would assist the reader in deciphering his text. In 1691, Richard Bentley made a serious request for assistance with reading the book, with the ostensible end of providing an argument that would articulate the connections between Newton's scientific findings and Christianity. Newton's response, found written in Bentley's hand with the title "Paper of Directions Given By Newton To Bentley Respecting The Books To Be Read Before Endeavoring To Read And Understand The Principia," demonstrates *crypticity* at its most sophisticated:

> Next after Euclid's *Elements* the Elements of ye Conic sections are to be understood. And for this end you may read either the first part of ye *Elements Carcarum* of John De Witt, or De la Hire's late treatise of ye conick sections, or Dr. Barrow's epitome of Appollonius.
>
> For Algebra read first Barthin's *Introduction* & then peruse such Problems as ye find scattered up and down in ye *Commentaries on Carte's*

> *Geometry* & other Alegraical[sic] writings of Francis Schooten.I do not mean yt you should read over all those *Commentaries*, but only ye solutions of such problems as you will here and there meet with….,
>
> For Astronomy read first ye short account of ye Copernican System in the end of Gassendus's *Astronomy* & then so much of Mercator's *Astronomy* as ye concerns ye same system & new discoveries made in the heavens by telescopes in the *Appendix.*
>
> These are sufficient for understanding my book: but if you can procure *Horologium oscillatorium,* a perusal of that will make you much more ready. (155-156)

What Newton is requiring of the reader, in this specific instance, his "friend" and fellow Puritan Robert Bentley, is beyond most of the Royal Society Fellows themselves. His reference to Euclid's Elements seems basic enough, until one realizes there are fourteen volumes. Having mastered those volumes, Newton is saying, though couching it in a tone suggestive of an easy afternoon's work, is a fairly exhaustive set of readings ahead, ranging from formidable texts on conic geometry to extensions of Cartesian analytic geometry—all areas at the cutting edge, so to speak, of mathematics of Newton's time. As if that were not enough, to merely begin reading the Principia, Newton adds in offhand way, one should read as well a set of specialized texts on astronomy. As a response to Hooke, these directions would perhaps make sense, as Hooke would be much more likely than Bentley to have read and understood the referenced texts, while also would be arguably deserving of an agonizing requirement of background material before Newton would concede Hooke's understanding. Yet the recipient is Bentley, a

sympathetic theologian by all accounts supportive of not just Newton's science but also his Puritan theology.

Purification

Since Newton's brilliant use of *crypticity* to make Principia inaccessible even to potential religious allies such as Bentley, readers—even friendly readers seemingly sharing Newton's theological goals—are left taking Newton on his word that the argument that is the Principia is sound and valid. However, where Newton is clear in the Principia is in indicating that Natural Philosophy is intermeshed with theology, as he concludes his discussion of God in the "General Scholium" with the comment that "to treat of god from phenomena is certainly a part of Natural Philosophy" (33). The way to "read" the world of phenomena, in order to "treat of God" from observations is summarized in Newton's "Four Rules of Reasoning," also known as "Rules of Consequence." These rules, I maintain, are not only clear expressions of the primary characteristics of modern science, they are also rules of *purification*, drawing their authority from a radically Puritanical understanding of God the Father. In Chapter Four, I trace how Newton uses very similar rules to purify the texts of the Judeo-Christian bible. Here, I position them as two-leveled arguments, which on the surface provide a very effective way of conducting empirical science, while underneath "authorize" the scientist-theologian to translate the self via the purifying act of translating into a substance approaching "perfection."

Newton's first "Rule" appears almost startlingly clear in comparison to Newton's reasoning in Books 1 and 2: "We are to admit no more causes of natural things than as are both true and sufficient to explain their appearances" (Principia 312). Following this statement, Newton offers an interesting argument, posing as almost an afterthought: "to

this purpose, the philosophers say that nature does nothing in vain, and more is vain when less will serve, for nature is pleased with simplicity, and affects not the pomp of superfluous causes." On one level, this seems an innocent statement asserting the Enlightenment characteristic of simplicity. However, note the language he uses—the "philosophers" are invoked here as authorities, and nature is anthropomorphized, and covertly feminine. Again, both limited appeal to ancient authorities and feminization of nature are commonplaces among natural philosophers of Newton's time, but read not as a deployment of a clichéd commonplace but rather as a serious statement, some intriguing possibilities emerge. This nature, idealized, is not vain but demure, and that demureness is equated with simplicity. Newton's nature here is an economical nature, whose esthetic is coupled to its parsimony—true beauty here is the beauty of the minimal, arguably a "puritanical" obsession with policing for the corruption of excess—in this case, excess of causes themselves. Perhaps not insignificantly, Newton's critique here of the "pomp" of nonsimple causal notions, sounds similar to his friend John Locke's critique of a feminized rhetoric in his Essay Concerning Human Understanding*:*

> Since wit and fancy find easier entertainment in the world than dry truth and real knowledge, figurative speeches, and allusion in language will hardly be admitted as an imperfection or abuse of it. I confess in discourses we seek rather pleasure and delight than information and improvement, such ornaments are borrowed from them as can scarce pass for faults. But yet if we would speak of things as they are, we must allow that all the art of rhetoric, besides order and clearness; all the artificial and figurative application of words eloquence hath admitted, are for nothing but to insinuate

> wrong ideas, move the passions, and thereby mislead the judgment; and so indeed are perfect cheats; and therefore… they are certainly in all discourses that pretend to inform or instruct, wholly to be avoided; and where truth and knowledge are concerned, cannot but be thought a great fault….(719)

A number of oppositions operate in Locke's passage: pleasure in discourse vs. information for improvement, judgment vs. passion, truth-telling vs. "cheating", and—implicit in Locke's faculty psychology—ordered and simplified mechanism vs. disordered and complex organism. Additionally implicit, if not at the crux of the matter, is the opposition of philosophy, a general philosophy much in line with Newton's Natural Philosophy, to rhetoric. Locke further invokes the opposition of gender in the ending lines of his harangue of rhetoric: "Eloquence, like the fairer sex, has too prevailing beauties in it to suffer itself to ever be spoken against. And it is vain to find fault with those arts of deceiving, wherein men find pleasure to be deceived" (720). Locke's vision of the ideal language—utterly masculinized in the sense of freedom from the seductions of pleasure, especially the pleasure of being deceived—is curious when compared to Newton's first rule, with its idealized and demure feminine Nature—and ordered and clear woman, subject to the laws of the father, if to "treat of God" through an understanding of nature, a nature purified to her real essence, which is, like Locke's clear-speak, free of "pomp" and ornament—dry, hard truths, expectedly unpleasurable. What Newton and Locke want is "truth," truth in expression in Locke's system, truth in "making sense" of phenomena, in Newton's system. Both rely upon a kind of violent decluttering of corrupt entities of language and nature. Locke even admits to being open to accusations of "brutality" for in his treatment of rhetoric, suggesting, considering the

seductress trope deployed, a rape of language akin to the systematic violation implied by Bacon's description of his ideal experimental science: "We will put Nature on a rack and torture out her secrets."

That "truth," in Newton's system, is beyond an ideal of simple: it is, as expressed in the second Rule, transcendent of species, geography, culture, or even planet: "Therefore to the same natural effects we must, as much as possible, assign the same causes" (Principia 320). This statement encapsulates generalizability, particularly generalizability of the first rule's simple cause. Interestingly, Newton has it include processes in everything from respiration to planetary motion—and in doing so, outlines the expanding map of what was once the province of the sublunary, but in Newton's "system of the world," is stretched from the human to the reaches of vastly space. However, this doesn't necessarily demand Latour's "crossed out god" response; that is, the separation of "spiritual" from material that is part of the conceptual constitution of the Enlightenment. Instead, Newton's design, given his hidden Arianism, doesn't so much cross out god as "reduce" God to the "creator" of the ideal system, which despite its apparent corruption, hides a simple, generalizable, lawfulness of order, free of the deceptions of perception and experience. In a sense, a dual slippage from alchemy and Arianism informs Newton's reasoning: God is the larger occult force who necessarily must "act" on the world; otherwise, his status as dominator is undermined. No—this God is in the midst of things, though not at first glance in any recognizable way because he isn't, as Newton argues, experienced directly or through reflection but instead as a causal originator and perpetrator of this universe. This is the Arian patriarchal Jehovah who cannot be divided nor removed from the whole of it: the world must obey his laws, and obedience reflects simplicity and order, much as it would in a Puritan household. To

"purify" the text of the world is to reduce it to its simple order, and to know God's simplicity and order is to transmute consciousness in such a manner, as it becomes a tool of structured observation. God in this system is the most alchemical and occult force of all: he acts not so much at a distance but with action-at-a-distance itself, at least in the case of gravity and the inverse square law.

Newton's third rule introduces the means whereby truth, and by extension, the Arian God, is known: experimentation. This rule first appears in the second edition, and "is of a different sort," as Cohen says, than the first two (Principia 199). The concept of generalizability is given more detailed outline here, interestingly, as Cohen notes, by an indirect appeal to the late medieval doctrine of "latitude of forms." Newton states: "The qualities of bodies… which are found to belong to all bodies within the reach of our experiments, are esteemed to be the universal qualities of all bodies whatsoever" (320). This quote appears to reaffirm generalizability, in this instance, generalization from one particular experiment to not just other experiments, but to phenomena outside the reach of experimentation. Newton follows this rule with the lengthiest passage in the entire "Rules" section. In this passage, he makes an argument for strong inference from experiments, mainly by operating in a radical mechanistic framework of inter-related and inter-changeable parts and wholes:

> The extension, hardness, impenetrability, mobility, and *vis inertia* of the whole, result from the extension, harness, impenetrability, mobility, and *vis inertia* of the parts; and thence we conclude the least particles of all bodies to be also extended, and hard and impenetrable, and moveable, and endowed with their proper *vis inertia*. And this is the foundation for all philosophy. (321)

What Newton is describing, as the "basis for all philosophy," is a systematic approach to conceptualize "nature," his ostensible object of study. At first glance, it may appear that the whole is valorized over the part, but Newton's argument is for the authority of experiment, which isolates a part of the system, studies it, allegedly free of other complications involved in the system, and then makes a statement about the nature of that particular deliberately isolated moment of the system's functioning. However, what Newton states in the third "Rule," and to what he is devoting the majority of his text in the "Rules of Reasoning," is an argument for a very liberal extension of the experiment's findings: the part contains the whole, and we know the whole by its part. In the language of this paper, Newton would have us read the text of nature by isolating a sentence, interpreting it, and then making a statement about the whole of it. Without a religious context, what we have is a radically objective science in the sense that we allow for no assumptions about what is true—other than the inherent truth of our method—to interfere with our discovery of real truths, as he says, we don't refute our knowledge through "dreams and vain fictions of our own devising" (Principia 320). Karl Popper's concept of falsification underscores that sense of radical objectivity, in which the emphasis shifts from demonstration, positive proof, in a manner, to what could be called demon-stration, in which the hypothesis is approached as the opposing argument, and refutation determines truth. Truth, in this system is what is left over after "rigorous" interrogation—negative proof, in the sense that truth is only that which cannot be dis-proved. This method of *purification*—of freeing truth from bias—appears skeptical. However, given "Rule" this is a direct, if not grand denial of Hooke's primary accusation, it also can be framed as a response to a skeptical refutation: what Newton significantly side-steps is where hypotheses come from in the first place. This reflects another

characteristic of Enlightenment thought: verifiability, only what is verified is from the outset treated as "questionable."

Newton's fourth rule, appearing first in the third edition of the Principia, and which Cohen maintains is "the most important of all," (Principia 2000), merges simplicity, verifiability, and generalizability into a seemingly complete scheme for knowing:

> In experimental philosophy we are to look upon propositions collected by general induction from phenomenae as accurately or very nearly true, notwithstanding any contrary hypotheses that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions. (Principia 321)

He follows this, the longest of all the "Rules," with the shortest commentary: "this rule we must follow, that the argument of induction may not be evaded by hypotheses" (Principia 39). On one level, this appears a most radical of "objective" sciences. The propositions collected by general induction are the global laws derived from the specific instances, and are akin to Platonic forms in their assumed universality, essentialness, and transcendence. This system excludes much—in terms of possible contributing or even contextualizing factors, notably what could be called "subjectivity," that is, human influence, at its extreme the mental construction of imaginary things, truths, or even systems of truth-value determination—"dreaming," "chimeras," and "feigning hypotheses," as crude examples, all frequently invoked, with obvious derogatory connotations, in Enlightenment writing from Descartes Meditations, to Locke's Essay to Newton's own work.

Again, these "Rules," one could argue, are exactly what they seem: clear, if somewhat quaintly expressed, characteristics of modern science. The "*purification*" involved is nothing but the systematic removal of preconceptions. However, note what this method excludes: the human as causal agent, except as "disinterested observer." Carried to its extreme, this method carries an invitation to violent domination by approaching the world as a set of corrupt "things" whose true purity is revealed only through dispassionate dismemberment. Strong language? Consider Newton's report of the following experiment he conducted in 1664:

> I took a bodkin [from the illustration accompanying this entry in the *Notebook*, astonishingly, this appears to be a small dagger similar to an envelop knife], and put it between my eye and the bone as near to the backside of my eye as I could; & pressing my eye with the end of it (so as to make the curvature in my eye) there appeared several white, dark, and coloured circles. Which circles were plainest where I continued to rub my eye with the point of the bodkin, but if I held my eye and the bodkin still though I continued to press my eye with it yet the circles would grow faint often disappear until I resumed them by moving my eye or the bodkin. (qtd in White 61)

Here we have Newton the Natural Philosopher following implicitly all of his "Rules of Reasoning:" a simple explanation is being sought for the interaction of the human sensorium and the stimulus light, the relationship is being concretely tested via "experimentation," and whatever the results, they generalizable to other "bodies." White's comment concerning this incident is indicative both of the incident's problematic nature and White's inability to account for it. White says, "Youthful enthusiasm and

dedication are one thing, but most people would agree that sticking a blade into one's own eye goes far beyond the call of duty. As a result, by nearly causing permanent blindness, he came close to destroying his scientific career almost before it had begun" (White 61). There is another explanation, but not that of the overly exuberant and dedicated scientist. Rather, this behavior is perfectly sensible to the deeply religious Puritan who believes understanding the workings of the universe will bring him closer to God. Violations of the physical integrity of one's own body, which "most people" would find unthinkable even with the ostensible motive of discovering knowledge for knowledge's sake, are doubly prescribed: overtly by the rigorous objectivity of the "Rules of Reasoning" and covertly by the demand to "know of God… through the frame of nature" (Yahuda Manuscript 41).

That demand, to know of God through Natural Philosophy, is to recognize the world is designed hierarchically, with the human's place in that hierarchy negotiable via alchemical translation of the self from base to pure (See Chapter Three), religious text translation from corrupt to pure (See Chapter Four), and scientific "translation" from corrupt local activity (Newton's sensorium responding to light, as in the above example) to pure global law. Newton's "call of duty," to use White's cliché, is not to acquire knowledge for knowledge's sake but to isolate, determine, and articulate God's laws, the basest of which are the physical. In the "General Scholium" of the Principia, Newton, though still cryptic, provides the real outline of his duty, which is to recognize the *Oneness* of God and the hierarchy that underlies that *Oneness*:

> He rules all things, not as the world soul but as the lord of all. And because of his dominion he is called "Lord god Pantokrator" (universal ruler). For "god" is a relative word and has referents to his servants, and

> godhood is the lordship of God, not over his own body as is supposed by those for whom god is the world soul, but over servants. The supreme God is eternal, infinite, and absolutely perfect being; but a being, however perfect, without dominion is not the lord god. For we do say my God, your God, the God of Israel, the God of Gods, the lord of lords, but we do not my eternal one, your eternal one, the eternal 0ne of Israel, the eternal one of the gods, we do not say my infinite one, or perfect one. These designations (i.e eternal, infinite, perfect] do not have reference to servants. The word "god" is used far and wide to mean "lord," but every lord is not a god. The lordship of a spiritual being constitutes a god; a true lordship constitutes a true god, a supreme lordship a supreme god, an imaginary lordship an imaginary god. And from true lordship it follows that the true God is living, intelligent, and powerful; from the other perfections, that he is supreme, or supremely perfect. (Principia 941)

This quote begins Newton's long argument concerning the relationship of God to "nature," or at least "nature" as is read through his Natural Philosophy literacy. The slippage constant here is from Newton's Arianism, and the critical principle—the assumption with which Newton implicitly begins and ends up concluding— is that this God of his has a number of traits. First, a radical hierarchy governing relationships between things, people, and "God" is assumed, in which language functions as both proof and maintainer of the sharp delineation between these three separate but connected worlds. Note Newton's deployment of "servants" to make demarcations not just between God, and us but also between other "lords" and God. The greatest servant here is Jesus himself—a name notably not mentioned once in Newton's entire argument, yet,

in light of Newton's Arian heresy, the best example he could offer here, the one he could not have but in mind, is of Jesus, our Lord, God's first "perfect creation." Secondly, this hierarchy involves a vertical continuum from imperfect to perfect, with god at the top, and "nature" at the bottom. The opposition to perfect in Newton's system is "corrupt"—and to extend the controlling metaphor of this paper, the task of the servant translator is to read the world free of corruption. Thirdly, Newton's God has "universal dominion"—as the quote above reiterates—and is single substance—as the Arian doctrine of *Homoussianism* maintains. Newton's God's universality is most radical: his God not only isn't reducible to the sum of its local manifestations, the "laws" determined through the rules of consequence, it somehow also doesn't actively participate in "phenomena," the stuff of experiments, while simultaneously managing to outline the very "rules" those experiments uncover. Newton maintains:

> It is agreed that the supreme God necessarily exists, and by the same necessity he is always and everywhere, it follows that all of him is like himself: he is all eye, all ear, all brain, all arm, all force of sensing, of understanding, and of acting, but in a way not human, in a way not at all corporeal, in a way utterly unknown to us. As a blind man has no idea of colours, so we have no idea of the ways in which the most wise God sense and understands all things. He totally lacks any body and corporeal shape, and so he cannot be seen or heard or touched, nor ought he to be worshipped in the form of something corporeal. We have ideas of his attributes, but we certainly do not know the substance of any thing. We see only the shapes and colours of bodies, we hear only their sounds, we touch only their external surfaces, we smell only their orders, we taste

> their flavors. But there is not direct sense and there are no indirect reflected actions by which we know innermost substances; much less do we have an idea of the substance of God. We know him only by his properties and attributes and by the wiser and best construction of things and their final causes, and we admire him because of his perfections. (941-942)

Notice the semiotic definition of God in this instance; "He" is defined more by what he is not than what he is. He is not human, embodied, or "sensible:" he cannot even be discerned indirectly by reflection off a surface. This God is overtly masculine, but not in a positive sense; instead the repeated uppercased masculine pronoun shunts aside any identity with the female, while still not defining a masculinity except as that which is not hot nature. This God is a most unCartesian God: he is ethereal in terms of his very pervasiveness, yet he stands so deliberately and unmeasurably outside the system over which he lords that he functions, rhetorically at least, as much more of a critique of the inadequacy of a purely Cartesian universe than as example of the kind of isolation of conceptual systems Shapin discusses.

However, just as we know not the substance of things through reflections but instead only attributes and properties, we can know of this God to the extent that we see "the wiser and best constructions of things and their final causes." The key here is what Newton means by "Perfection," especially in opposition to "Corruption." God in Newton's system is more than perfect: he is the form—as well as the former—of perfection. The "true God", as he says, is "supreme, or supremely perfect." What constitutes the essence of this perfection, I maintain, is a radical *Oneness*. That *Oneness*, evocative of both isolation and supremacy, is for Newton a literal description of God, as

in "God is one and the same god always and everywhere." Conceptually, the *Oneness* extends to conceive of God—to translate towards perfection—that starts and ends with the assumption of a law of the one, so to speak, which subsumes oppositions such as corrupt vs. pure, global vs. local, and simple vs. complex. These three oppositions, in particular, are at the crux of Newton's slippage of Arian theology into his Natural Philosophy. This *Oneness* is also reflected in Newton's belief in the "Unity of Matter," that is, that all matter was initially of one pure sort—a concept Dobbs maintains was evident in both Newton's Natural Philosophy and his alchemy (22-23).

Without Revelation

Given Newton's *crypticity* in the*Principia,* along with his "Rules of Reasoning" drawing their ultimate authrority as a system of *purification* from a complex God the Father characterized by *Oneness*, the book is a Janus-faced bible of science. On the surface, it appears a bible of secular science, as it provides a reasoned if obtusely rendered argument, mathematically and empirically supported, that models the very epistemological criteria presented in the "Rules of Reasoning." Disproof, from that vantage, appears to be the methodological rule of the day. But from the depths of the book, especially in the "General Scholium," emerges a less secular bible: a way to read the book of nature to reveal not just God's laws but God as simple, generalizable, and verifiable lawfulness itself. What Newton's method does, if we are to take his comments in the "General Scholium" seriously rather than as a Deist apology, is systematically "prove" God's lawful design at each moment, and that design for the Arian is severely rank-ordered.

Constructing Community II: The Calculus of Conflict

In this section, I return to examination of Newton's experiences with the Royal Society, again tracking in his letters the same three characteristics of *crypticity*, *Oneness*, and *purification*, evident in both his communication with Hooke and in the Principia. At issue is the "scientific community," as it was with Newton's earlier exchanges with Hooke. This time, however, Newton is no longer the young challenger from the hinterlands of Trinity College. Instead, he is the reigning Royal Scientist, in large part due to the reputation he began to construct with his earlier exchanges with Hooke, and brought to a level making him "closer to God than any other," as Halley says, with the publication of his unreadable Principia. In 1703, at age 60, Newton was elected president of the Royal Society, where he immediately began to reform the nearly defunct institution (White 285). As White notes, "The Royal Society was saved not only by Newton's impressive administrative powers (the positive side of his incendiary ego and hunger for power) but also by his own example as a paradigm for how science should be conducted. And he set the tone immediately" (285). Certainly, his first major presentation of scholarship to the society following his election, the Opticks, was, as Westfall maintains, his "second great work" (251) of Natural Philosophy. Additionally, under Newton's direction the Royal Society became an entity more explicitly constituted as an institution of "modern," empirical scientists. Westfall writes,

> Newton was aware that meetings lacked serious content, and he came to the presidency armed with a "Scheme for establishing the Royal Society" intended to cure the disease. …He went on to set down five major branches of Natural Philosophy, for each of which, presumably, he looked forward to appointing a pensioned demonstrator: mathematics and

> mechanics; astronomy and optics; zoolology (to use our word), anatomy, and physiology; botony; and chemistry. (249)

To read White's, Westfall's and almost any account of Newton taking the reins of the Royal Society suggests he was applying, metaphorically, a kind of calculus of community, differentiating at each step the trajectory of the community, while simultaneously integrating the area(s) covered under that trajectory.

However, Newton's metaphoric calculus of community trajectory takes on a sinister tone when the issue is the real calculus itself, what Newton called "Fluxions." In keeping with the Principia's *crypticity*, that is, in making the book overtly a "clear" scientific treatise while covertly thwarting a reader's ability to understand and therefore critique Newton's argument—and by extension, the author himself—Newton had deliberately concealed the particulars of his mathematical method (Westfall 280). In 1684, Gottfried Leibniz published his version of the calculus (Westfall 276), officially making not only public the method of integration and differentiation but also providing a symbolic notation so much less cumbersome than Newton's that it is the notation in use by contemporary mathematicians and scientists.

Newton's reaction is most ungentlemanly: he not only refused to admit the possibility that each scientist had developed the method on his own—the conclusion of the majority of historians of science—he used his position at the Royal Society to publicly humiliate the German philosopher. White's interpretation of Newton's motives is interesting:

> Newton maintained an obsessive belief in his own uniqueness: he was convinced there could be only one Christ-like interpreter of divine knowledge in the world at any one time, and he never doubted he was the

> chosen one. The idea that others could independently acquire the same insights and accomplish the same breakthroughs as he had was simply unacceptable to him. So Leibniz was a thief who had stolen the knowledge Newton has unveiled, and had then profligately displayed the material to the world. (White 331)

Again, White's analysis of the factors giving rise to Newton's behavior is primarily psychological, acknowledging the "madness" of Newton's behavior yet still distancing that behavior—and the above motives—from the overall theological system Newton employs. That "madness," I argue, is not merely "normal" but nearly inevitable when situated as a logically consistent part of Newton's overall system of understanding the world(s), of his overtly discrete yet covertly entangled literacies, in the language of this paper. Newton as "Christ-like interpreter of divine knowledge" captures the covert entanglements of Natural Philosophy, with its Rules of Reasoning, of alchemy, with its commitment to transmutation of the self from base to pure, and of Arianism, with its hierarchical arrangement. Newton's belief that others could not arise at the same knowledge he had is more than merely "unacceptable:" it violates assumptions foundational to Newton's entire intellectual enterprise, threatening not just Newton's self esteem but the very structure of the universe. In short, Newton's notion of hierarchical arrangement excludes the reality of a truly "communal" understanding: to be consistent to his own system, Newton is forced to police the community of scientists, purifying the body "scientifique" of the worst form of corruption: idolatry.

What White does not explore in detail is Newton's actual rhetorical tactics in purifying the Royal Society body of its "foreign" member, tactics not merely indicative of a "harsh" character but of Newton's commitment to *crypticity*, *Oneness*, and

purification. The text that brings the issue to a head is a letter Leibniz writes in 1711 to Hans Sloane, Secretary of the Royal Society. In it, he responds to accusations made by both Nicholas Fatio de Duiller and James Keill, the latter's accusation in the very public form of a published letter in the Society's Philosophical Transactions. Significantly, both de Duiller and Keill were well known Newton apologists, with de Duiller attacking Leibniz in a 1699 monograph and supporting Newton, and Keill, intensely involved with revisions of the Principia, "Newton's mouthpiece" (Westfall 282). Leibniz's response to the published assertion that he may have plagiarized the calculus is unequivocably outraged:

> Mr. Keill … has seen fit to renew this most impertinent accusation when he writes I have published the arithmetic of fluxions invented by Newton, after altering the name and style of notation. Whoever has read and believed this could not but suspect that I have given out another's discovery disguised by substitute names and symbolism. …And because it may be frequently repeated by impudent or dishonest people I am driven to sek a remedy from your distinguished Royal Society. (97)

Newton's official response, as President of the Society, is to have the letter read publicly and then present orally his own history of his development of the fluxions (Westfall 283). Keill, still acting as Newton's mouthpiece, responded to Leibniz's complaints in a letter to Sloane, again presented orally to the Society. In it, the issue of nationality arises:

> Since he [Leibniz] possesses so many unchallengeable riches of his own, certainly I fail to see why he rishes to load himself with the spoils stolen from others. Accordingly, when I perceived that his associates were so partial towards him that they heaped undeserved praise on him, I supposed

> it no misplaced zeal on behalf of our nation to endeavor and make safe and preserve for Newton what is his own. For if it is proper for those of Liepzig to pin on Leibniz another's garland, it is proper for Britons to restore to Newton what was snatched from him, without accusations of slander. (143)

As Westfall notes, no direct manuscript evidence exists proving Newton's involvement with the Keill letter, "but everything about it—its intimate knowledge of Newton's early papers and correspondance, details of its argument... and above all its style… cries aloud of the hand that shaped it" (283).

That "hand," however, does something well documented in the historical record: Newton calls for an investigation into the matter, publicly once again playing the role of the disinterested scientist wanting only the truth to come out. Behind the scenes, Newton's manipulation of the Society reflects a very sophisticated form of *crypticity,* driven by his commitment to *Oneness*, and characterized by justification of the questionable means of *purification* via policing towards the end of a "pure" community of scientists. Those means included a stacking of the investigative committee with Society Fellows sympathetic to Newton, denial of Leibniz's right to present evidence, and Newton himself writing a draft of the report (White 337) which would become known as *Commercium epistolicum D. Johannis Collins, et aliorumde analysi promota (The Correspondance of the Learned John Collins and Others Relating to the Progress of Analysis).* Westfall, generally sympathetic to Newton, calls the *Commercium epistilicum*

> a brilliant exercise in partisan polemics which testified to Newton's continued mental vigor as he approached the age of seventy. …the total impact of the notes, the total impact of the whole volume in the absence of

> anything in Leibniz's defense, is devastating. Perhaps it is too devastating. Swept along by his own fury, Newton failed to recognize the value of moderation. No doubt the volume informed a particular public of events that Leibniz had not been forward to advertise. (285)

Westfall's phrase "brilliant exercise in partisan polemics" is another way of saying that Newton's skill in *crypticity*, that is, in maintaining an overt stance of the disinterested scientist while covertly promoting his self-interest, reached its apex in his treatment of Leibniz. Newton, by using first de Duiller, then Keill, and finally the Society itself rhetorically positions himself above the fray while actually manipulating the discourses—even to the point of writing the document while denying its authorship.

The immediate result of this "secret policing," Newton's method of *purification* in the language of this paper, was exactly the end to which Newton's system of systems unvaryingly aimed: maintenance of *Oneness,* in this instance, of a single Lord of science, standing over the lesser folks while ascending ever closer to God the Father. Leibniz, not surprisingly, responded repeatedly to the *Commercium epistilicum*, primarily through venues involving neither the Society's meetings nor the Society's *Transactions* (White 338). However, as White notes, "Leibniz [sank] fast into fatal illness and neglect—a man equal to Newton intellectually but outclassed and outgunned in all other respects" (339).

In contrast to the short term success Newton's tactics engendered, the longer-term results of Newton's exercises in *crypticity*, maintenance of *Oneness*, and *purification* in creating an "ideal" scientific community are less than desirable. Boyer, in A History of Mathematics, describes the community aftermath of Newton's machinations:

> As a consequence of the disgraceful priority dispute [the issue of the calculus' inventor], British mathematicians were to some extent alienated

> from workers on the Continent throughout much of the eighteenth century. A penalty for the unfairness of followers of Newton towards Leibniz was thus visited on the next generation of mathematicians in England, with the result that British mathematics fell behind that of Continental Europe. Upon his death, Newton was buried in Westminster Abbey with such pomp that Voltaire, who attended the funeral, said later, "I have seen a professor of mathematics, only because he was great in his vocation, buried like a king who had done good to his subjects." Nevertheless, despite the recognition accorded mathematical achievement in England, development of mathematics there failed to match the rapid strides taken elsewhere in Europe during the eighteenth century. (414)

Scholium Redux

Newton's Natural Philosophical work, as I have traced, is anything but a system of thought that is exclusive and disproving of such premodern systems such as alchemy and Arian theology. Instead, Newton's Natural Philosophy draws both divine authority and radical hierarchy from Newton's hidden Arianism. By situating Newton's within the community of Enlightenment players and his writing within the community of Enlightenment ideas, I noted certain radical concepts and strategies reflective of his hidden studies consistently emerging, including *crypticity, Oneness,* and *purification.* By foregrounding these principles as foundational assumptions concerning the nature of reality, I offered a framework for a rhetorical analysis of Newton's work which suggested Newton's Natural Philosophic studies, his literacy in reading the book of nature, on the surface a compelling model of secular science, is covertly driven by hidden principles that allow for certain subjectifications under the guise of objectivity. At the minimum,

Newton's deployment of Natural Philosophic texts to manipulate and wield social power, with considerable success, suggests the discursive formations characterizing the practice of science meet ends both referential and persuasive, with the strength of the persuasion, ironically, determined in part by the degree of seemingly self-evident referentiality. In short, scientific discourse may be most effective rhetorically when it denies its own rhetoricity—what I have been calling *crypticity.*

At the maximum, Newton's hidden theological conceptual support for his method of doing science suggests both a certain utility in what many would consider an inherently contradictory approach and a built-in limit of Newton's method. That is, Newton's very "Rules of Reasoning," encapsulating in part the primary characteristics of modern science, may be less immutable criteria than partial frames for understanding the world, with *Oneness,* initially an invitation to productive epistemological development, now inviting a complementary response. In light the productive nature of Newton's use of seemingly opposed systems to provide a more exhaustive description of the world, in Chapter Five I examine in more detail Newton's system of systems, juxtaposing it to Bohr's complementarity, demonstrating that although both thinkers were similar in their revolutionary approaches to epistemology, Bohr's complementarity, in the end, offers not only more possibilities for exhaustive description in itself, but more critically provides an epistemology of epistemologies that both accounts for and extends Newton's science. In Chapter Six, I return to Newton's "Rules of Reasoning," arguing for a Bohrian complementary set of characteristics for post-modern science to provide potentially productive epistemological frames for development of both a human and a humane science.

Finally, Newton's Natural Philosophical work, situated within the social matrix of Seventeenth and early Eighteenth century England, contributed to potentially troubling subjectifications, including development and maintenance of an elite community of scientifically literate scientists and an invitation-to-sanctified-mechanization that allows for the part-whole relationship to extend to the citizen-community. Of particular note, and in part the topic of the next chapter, is the subjectification implied in Newton's nearly invisible category (and perhaps "category invisible") "Woman." To an extent, Newton's Natural Philosophic literacy, based as it is upon a hypermasculinized ideal of God, is a method of reading that practices a violent *purification* of nature, stripping her of her femininity, and what remains is what constitutes "Knowledge." In the next chapter I examine Newton's alchemical texts, where the trope of the woman emerges from the shadows of his Natural Philosophy, and Newton "admits" her, much as a spider admits a delicious mate.

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CHAPTER THREE

FROM MOTHER'S LAP TO THE SHOULDERS OF GIANTS: THE FINE AND PRIVATE PLACE OF NEWTON'S BOOK OF THE SELF

Being of opinion you have endeavored to embroil me with women & by other means I was so much affected with it as that when one told me you were sickly & would not live I answered it was better if you were dead.
Letter to John Locke, 1693

& that by a strange metamorphosis done by magical virtue of nature & that after this rise she was naked, that is divested of impurities & beautiful & though a body yet she was all spirit & yet able to endure without hurt ye greatest fires that can be made & in this state it is properly of matter in which vulgar chemists do not work & which is not to be found upon ye earth of the living, tis not the earth wee tread on but that which by sublimation hangs over our heads, and which the wise call terra virginea foliata.
Isack Newton. "Praxis".

Isaack
received your letter and I perceive your letter from mee with your cloth but none to you your sisters present thai love to you with my motherly lov you and prayers to god for you I your loving mother.
Hannah
Hannah Newton. Letter to Isaack Newton., 1663-64.

The Quintessence is …[the] essential presence of something or someone, the living thing itself that animated or gave something its deepest characteristics. The Quintessence partakes of both the Above and the Below, the mental as well as the material. It can be thought of as the ethereal embodiment of the life force that we encounter in dreams and altered states of consciousness. It is the purest individual essence of something that we must unveil and understand in order to transform it.
"Quintessence."(Electronic Dictionary of Alchemy)

The first two quotes above date from 1693, Newton's "Black Year," as historians later called it. The "Black Year," as a kind of dark side of the Enlightenment genius, contrasts and complements Newton's "annus mirablis, "the wondrous year," the roughly 1665-1667 period when Newton supposedly worked at the most revolutionary aspects of his Natural Philosophy, including the development of his "fluxions," or calculus. These

two quotes are examples of Newton's "mad texts." In the first quote, Newton is writing to John Locke and, according to Samuel Pepys, is exhibiting an obvious "discomposure in head, mind, or both" (Pepys 280). The second quote is taken from "Praxis," a sort of Alchemical Principia, or at least Newton's attempt to write an extended treatise similar to the Principia in comprehensiveness and contribution. Almost all contemporary receptions of "Praxis" treat it as at best a waste of effort, and at worst, as one historian says, as a "last-ditch effort at a unification produced from disparate alchemical threads…little more than a blend of naked delirium and false conviction—the work of a man on the edge of madness" (Pepys 280). In short, both Newton's scientific contemporaries and even more innovative contemporary historians of science, such as Michael White, treat these texts as "nonsense." However, both responses are dismissals—negations—in that by making these texts nonsense, the texts are only allowed to demonstrate exceptions to a certain set of rules, and those rules include a very modernist conception of psychological normality and an equally modernist conception of disciplinary normality—"science," in this instance. These texts are now "read," though mostly in the last half of the twentieth century, and even then as potential evidence of Newton's turmoil over a suspected more or less latent homosexuality, in the case of his letter to Locke, or as evidence of a wayward intellect, rationalizing the fundamentally irrational, as in the case of his alchemical writings. In this chapter, I argue that another interpretation is possible: in those moments in his alchemical texts where Newton deploys the trope of the female he reveals he is working within interlocked and hierarchically arranged systems of representation. These systems, including Natural Philosophy and Arian theology, are brought together with alchemy as a bridge between a purifying translation of the feminine

book of nature (Natural Philosophy) and a purifying translation of masculine book of God (Arian Theology) in order to effect a purification of the text of the "self." In that sense, Newton's texts are sane to the extent that they at least consistently reflect his psychologically ambivalent stance towards not just women, but towards all people in general, with category women not just at the bottom of his human hierarchy, but with Newton himself at the top, so that all are beneath him.

How Newton could gain not just such a negative sense of the female but of people in general is understandable in light of his first critical relationship—that with his mother. That relationship can be summed up in a word: betrayal. The initial betrayal, his mother Hannah leaving him with stern, puritanical grandparents from the age of 3 to 11, is really the result not of a negligent mother, but of a set of circumstances that invited Newton's mother to survive as best she could following the unexpected death of Newton's biological father, in 1642, just months shy of Newton's birth. This unexpected death of the primary source of income left Hannah, though receiving a better than subsistence per annum, far less well off than she might have been had her husband survived. For three years, from Newton's birth on December 25, 1642 to 1646, the two lived alone on the income, by all accounts an especially close mother-son dyad. However, Hannah married Barnabas Smith, a moderately wealthy landowner over thirty years her senior, when Isaac was nearly four. Surprisingly, the aged new husband lived nearly ten more years and fathered three children as well. From the start, stepfather Smith wanted nothing to do with Isaac, and seemed to actively discourage contact between mother and son. The third quote above, the short letter from Hannah to Isaac, and the only textual artifact extant demonstrating her feelings for her son, dates to well after the abandonment period, during

his undergraduate years at Cambridge (White 248). To make matters even worse for Isaac, while separated from his mother, he is able to climb a tree in his grandparents' yard, and see the steeple of North Witham's Church, near the Smith estate, a painful reminder, according to Christianson, of how "agonizingly close" his mother was (12). Christianson notes that the loss of his mother "ate at him like an emotional cancer. …The abandoned son not only possessed a volatile temper, but he nursed grudges and would wait years, if need be, to gain revenge on those he believed wronged him" (12).

What are we to make of this fact of Newton's atypically close relationship with his mother, followed by just as atypically abrupt separation? The scenario certainly lends itself to a crude Freudian analysis, in which the child's symbiotic bond with the mother is first over-constructed and then too harshly violated, leaving the child not only generally mistrustful, but also specifically hateful towards the surrogate "father." Given some of Newton's behaviors following his return to his mother, another frame is more appropriate, namely to see Newton in an Adlerian context, in which his initial relationship with his mother, where the "stranger in a strange land," as Adler calls the infant, initially has not only his needs met, but is made into a kind of prince. Adler's psychology is fundamentally a social psychology, in which initial family systems and the roles within those systems become models and predictors of a person's behavior and worldview when the person reaches adulthood. At the crux of Adlerian psychology is a drive towards superiority, paralleled by a sense of inferiority. The basic response to the feeling of inferiority is "compensation," in which the will to superiority drives the person to achieve in areas in which superiority is possible (Hall and Lindzey; Corsini).

For Newton, a significant event in his life that demonstrates not only how he literally began to achieve a sense of superiority but how, from an Adlerian point of view, he began to see himself as superior, is his fighting with a bullying classmate. In describing this incident, Newton depicts himself at the time after his return to his mother as a poor student who was small and the frequent victim of schoolyard bullies. However, when the worst bully, who is also one of the best students in Newton's class, attempted to beat Newton, he responded with a ferocious physical attack, soundly trouncing his tormentor. Further, after the trouncing Newton told the bully, as well as the attendant crowd of watchers, that he would beat him at scholarship as well. According to Newton, this incident marks the moment when he became the top student in his class (Westfall 13-14).

What is most interesting about this fight with the bully is Newton's linking of physical dominance with intellectual dominance, so that to achieve superiority, to use Adlerian terminology, Newton intellectually trounces all comers. This coupling suggests Newton's approach to scholarship, and perhaps all significant human endeavors, is a brutal game of survival of the fittest, and in the end, there can be only one. Given his initial status as prince coddled by his mother, followed by the dethroning and long period of isolation at his grandparents' house, it seems almost inevitable that he would end up approaching interactions with other people with an increasing mistrustfulness. Additionally, the one area where he truly excels to the point of drawing the attention of authority figures is the intellectual, particularly those areas which could be lumped together in retrospect as "scientific." However, those authorities are as much dangerous competitors as selfless collaborators: his early story of trouncing the intellectually and

physically "superior" bully is matched by his behavior from this moment onward. He is, as Dobbs says in Newton and the Culture of Newtonism, a "loner," but a peculiar loner who is involved deeply in other people's endeavors, many times in vindictive ways, so that a recent book, Newton' s Tyranny, which focuses primarily on his relationship with Flamstead and Grey, could serve as an apt title for Newton's life, from his early days at King's, to his days as Lucasian professor at Trinity, to his work at the London mint where he rules with a firm and methodical hand (Clark and Clark).

The attention that Newton begins to receive from authority figures, exclusively men, following his fight with the bully does offer Newton a set of circumstances that allow him to codify his drive to superiority over others, which involves a stark sense of hierarchy and dominance. This radical hierarchy applies not just to Newton's sense of place in the flux of human affairs, but in the three worlds in which Newton works intellectually—the world of nature, the world of self, and the world of god. These worlds themselves, each a form of corrupt text, contain essential pieces of what could be called the Holy. Nature's text, purified of its variations, provides god-determined laws, from thermodynamics, to gravity, to vitalism. The self-text, consciousness itself, purified of its profanities, provides a pure creation, analogous to Jesus. Finally, God's literal text, purified of its mistranslations, provides prophecy—"what will be" revelations, perhaps the complement to Natural Philosophy's revelations of "what is." For Newton, these three texts and corresponding translations are also arranged hierarchically, so that base "she" nature is at the bottom; the self, potentially at least, is between the material world of nature and the immaterial world of God the Father, the idealized "He" imperiously placed at the top of the heap. In this scheme, alchemy enters conceptually between the embodied

profanity of nature and the disembodied sanctity of God, between the purifying methods of science and the purifying methods of scriptural interpretation. Alchemy is not in Newton's hands "Base chemistry," that is, greedily attempting to transmute lead into gold, but instead is about the transmutation of the self from a base form to a higher form, requiring an active participation of the experimenter himself with the physical processes contained in the alchemical experiment. This dual transformation process makes of the practice an interesting exercise in power, where a power over the self exercised through purification, effects and is evidenced by a concurrent power over the material world. Alchemy in this scheme not only raises the spiritual rank of the individual but the secular rank as well. Conceptually, this practice of a material reward following a spiritual purification elegantly resembles the Puritan work ethic, where God's chosen reinforce their having been chosen in the first place by working hard and receiving His bounty.

Newton's introduction to alchemy occurs when he is simultaneously a disappointment to his mother and a success in school. Following the epic battle with the schoolyard bully, Newton moves quickly to almost the top of his class. However, he is admittedly lax about farm work and any duties associated with what could be called his mother's world of managing a substantial estate. Apparently to keep him occupied, as well as to give him quarters close to school, Hannah arranges for Newton to live with a local apothecary at Grantham when he was enrolled at the King's School there (Christianson 12). In return for helping with the chemist's work, Newton is given room, board, and access to the apothecary's formidable library of alchemic and other texts, as well as access to the library at St. Wulfram's Church in Grantham, which contained numerous theological works, including Arian Puritan tracts (White 20). Importantly, in

terms of Newton's possible psychological development within the frame of Adlerian psychology outlined above, this period between his reuniting with his mother and his entry into Cambridge is a critical stage for psychological development, having, as Erik Erickson says of the early and mid teen years, the task of resolving not just issues of identity but also establishment of an overall world view, particularly in terms of relationships with others (Engler 179-180).

Given the "psychological" basis of Newton's form of alchemy, that is, a form of alchemy that attempts to transform the self, with experiments in the physical realm acting as both locii of focus for symbols of transformation and, when successful, evidence of increasing purification of the alchemist, along with his introduction to it at a critical period of adjustment, my claim is that Newton's alchemical writings, especially those associated with his "mad years," can be read as both representations of and grappling with psycho-social "pathologies" he developed as a consequence of his relationships with others during his childhood. In this manner Newton's texts revealing his most serious practice of alchemy, which according to Dobbs began in earnest in 1668 during his two years between his undergraduate and graduate work at Trinity, and culminated in 1693, during his so-called Dark Year, can be read as indicators not only of his psychology, but of his worldview either implicitly or explicitly informing his work in theology and in Natural Philosophy. At issue in these texts is power, especially the power to transform the self and the material world, all drawing the fundamental warrant from a puritanical world view operating on the assumption that the grand system of the world is arranged in strict rank order. That worldview is, from my perspective, dangerous and dark, where binary thought and hierarchical representations rule the conceptual systems, and the one

who best understands that hierarchy and those systems, also "rules" within the embodied social systems of his day. Ruling, however, is not necessarily a public act. For example, Newton was a Member of Parliament in 1688 as the representative from Cambridge. However, during that period all that he supposedly did was request an usher to shut a window, as there was a draft in the chambers (White 197). Whether this story is true or not, Newton's failure to exercise overt public power in that venue, fitting as it does an easy description of the lofty Enlightenment Genius standing above the sordid affairs of the polis, also fits a description of a man obsessively concerned with secrecy, and working behind the veil, whether of the material world of base elements or the social world of base people.

Newton's working behind the veil of the material world is another way of describing not just his alchemical studies but also his psychology itself. His most private intellectual endeavor, the work of alchemy which ranges from grappling in numerous ways with ancient texts to performing experiments in the laboratory, is, given the Adlerian social context of a will to superiority, predicated upon identification and maintenance of strict social hierarchies. Within this hierarchy is the "female," a contested region for Newton, as desire for the mother coupled to fear of betrayal, complicated by rivalries with the "male," is symmetrically reinforced by his personal experience and the general system of Natural Philosophy, which places the female at the bottom, the root of corruption, the earth itself. To recover his mother, and an ideal of the female, Newton must simultaneously remove the corruptions of competitors—the presence of the male. He must return her to an ideal, unsullied state: a female that is pure essence of female.

That essential female that emerges in Newton's alchemical writing, importantly, does not just reflect a problematic category woman but a problematic system of categorization itself, of which "female" and "woman" are especially dramatic sites of expression of the system's overall radical hierarchicalization. When Newton engages in three alchemical tasks of "translation—" translating texts of the ancients, commenting upon translation of texts of the ancients, and creating new texts of his own—he provides, in his tropes of the female, three inter-related yet different aspects of overall assumption about where the female fits in the scheme of things. To get at his complicated and ambivalent sense of the female, I next approach three texts drawn from those three different alchemical "translation" tasks. These sets of texts lie on a continuum of "authorship," in which the first set of texts, the literal translations, with "La Lumiere Sortant des Tenebres" as example, are the least Newtonian, in the sense that he is translating the work of others. The middle set, as commentary on specific texts of others, includes his "commentary" on The Emerald Tablet as an example, and represents a middle ground between Newton and the ancient authors. Finally, the last set, with "Praxis" as the prime example, represents Newton as his most authorial in that it is entirely his work, drawing upon other authorities only as one would draw upon sources for one's own argument.

In Newton's direct translation of texts of the ancients, such as "La Lumiere Sortant des Tenebres," the trope of the female reveals both "corruption" and "power" as associated aspects. For examples, in describing the role of the true alchemist, Newton says:

> The sages use not violent flames nor burning coals like ye vulgar chemists but imitates Nature and her work with her fire: a fire vaporous and yet not light, a fire which nourishes and devours not, a fire natural and yet made by art, dry yet causing rain. Nature begins; Art finishes and alone purifies what nature could not purify. And unless art make plane the way nature will stop (Newton "Cant 3" 281).

Note first the binary that goes throughout this and almost all of Newton's alchemical writing: sage vs. vulgar chemist. The sage is a "true hermetic philosopher" who has more at stake in alchemy than " the transmutation of metals" as he says to Odenburg in a 1676 letter (Correspondance, Vol. 2 2). There, he strongly cautions Odenburg about revealing secrets in a recent publication to those who are not spiritually pure enough to handle them. The sage, in this scheme, operates between the sub- and superlunary in the sense that he partakes of corrupt nature, yet goes beyond through an art of purification, functioning both as a liaison between the profane and the sacred and as an active catalyst to remove of nature the profane and let remain what is sacred. This "nature," in both the quote above and in the system itself, is overtly female. She contains this "fire" this power of transformation from impure to pure, yet cannot effect it alone; left to her own devices—unless "art make plane the way"—she will "stop," that is, remain unpurified, untransmuted. The "art" is the practice not of the chemist but of the sage, the real alchemist, the ideal male in the sense that he uses what is already in the female to effect her own translation—he pulls her up to a higher plane, so to speak. How he does this is to use a strange power within her that is full of seeming contradictions: "vaprous and yet not light," "dry yet causing rain," and, most significantly, "natural and yet made by art."

These descriptors are not to be read as antithetical but as the opposite: as complete descriptions whose seeming contradictions are re-solved by changing the rules of resolution. Specifically, "natural and yet made by art" describes the effort of the Arian alchemist to recover the initial purity of the world by recognizing and then manipulating the vestiges of purity that remain even in the most corrupt aspects—here, the earth, the female, the lowest of the sublunary. The female isn't excluded but redirected in this scheme, always under the auspices of the male. Consider this description of the feminine aspect in the animal, also taken from "La Lumiere Sortant des Tenebres":

> In the feminine sperm of animals the passive elements are predominant & in the masculine the active, whence arises the mutual action between them in order to generation, to which the acid quality of the menstruum or feminine sperm contributes & so in the other kingdoms for ye feminine sperm is sharp and pontic and by its nitrous sharpness and crudity introduces putrefaction. Without putrefaction tis impossible to attain your end, viz the deliverance of the sulpher or seed shut up into the prison of the elements. This is the only means: for if the seed be not cast into the earth to putrefy it remains unprofitable. Now this corruption is not compassed but by a proper menstruum. In animals this menstruum is in the womb. In vegetables tis in the earth. In minerals tis in the proper matrix which is taken for earth." (Newton. Appendix C. In Dobbs' Janus 282)

Here, the trope of the feminine, applied to the animal world, also contains both corruption and power, especially the power to move from base to pure. The negatives associated

with “feminine sperm” include “sharp,” “pontic,” and “crude,” all giving rise to “putrefactions,” the breaking down of elements into constituents through a kind of rot, that is, a controlled corruption that, if its course is directed, gives rise to the opposite of corruption. The freeing of the “seed” in the elements, literally sulfur here yet figuratively the power of purification itself, is “natural” in the animal kingdom and the plant kingdom, but in the mineral, the place at which the alchemist inserts himself to practice his art, it is in “the construction of the proper matrix which is taken for earth.” In this act, the alchemist creates a kind of womb in the experiment, taking on through manipulation the generative power of the female while simultaneously not fully identifying with—and perhaps becoming infected by—the corrupt “nature” of the female but by taking over the processes. In that sense the alchemist usurps the power of creation of the female by appropriating her corrupting tendencies in order to go beyond corruption.

However, as Dobbs says of the text above, “although much of the material … is not Newton’s own composition, since the material is abstracted rather than simply transcribed, it contains the parts of the book that Newton found important” (280). What we have here, then, is Newton’s twist on the received wisdom of the ancients, reflecting perhaps more Newton’s understanding and acceptance of the general practice and assumptions governing alchemical practice, especially the “true” hermetic tradition, than Newton’s own unique invention. Still, as Dobbs notes, we have Newton’s refraction of not just ideas but a particular expression of those ideas, in this instance, the use of a female trope to describe the relationship between the alchemist and the intertwined worlds of nature, self, and spirit.

When moving beyond transcription, and adding commentary to the alchemical record, Newton not only continues the tradition of deploying feminine trope but intensifies its use, building upon the concepts outlined above, especially female as base and yet also as the source of the power of translation into more purified essences. Consider the following from the very beginning of Newton's "Commentary" on The Emerald Tablet of Hermes Trismegistus:

> The things that follow are most true. Inferior and superior, fixed and volatile, sulfur and quicksilver have a similar nature and are one thing, like a man and wife. For they differ one from another only by degree of digestion and maturity. Sulfur is mature quicksilver, quicksilver is mature sulfur, and on account of affinity they unite like male and female, and they act on one another, and through that action they are mutually transmuted into each other and procreate a more noble offspring to accomplish the miracles of this one thing. (Newton "Commentary" Appendix B Dobbs Janus 276)

As in the "La Lumiere," Newton again deploys sharp binaries of male and female, associating with female inferiority and passivity, and with the male superiority and activity. Here, though, the admixturing is even more pronounced: the male and female facets of the world entire, are brought together, unified as attracting complements, to produce "more noble offspring." What is most provocative is the literal offspring to which Newton is referring: higher consciousness birthed within the marriage of "The Sun and the Moon" as he calls it. Additionally, Newton likens this process of both a chemical marriage and a psychological union of what is considered male and female to the very

way in which God created the universe: “And just as all things were created from one chaos by the design of one God, so in our art all things, that is the four elements, are born from this one thing, which is our Chaos, by design of the Artificer and the skillful adaptation of things” (Newton “Commentary” Appendix B Dobbs Janus 276). In this comparison, Newton reveals his Arian take on alchemy. The Puritan alchemist acts like god in creating, and to the extent that God’s creation is accurately mimicked, one gets at “the source of all perfection in the world.” One gets in line to reach towards the heights occupied by Jesus, not Jehovah’s equal-in-stature son but God’s best work.

The method of acquiring near Jesus status, as he describes it, is eerily sexual: by making “material ascend into heaven through sublimation and then through reiteration of the sublimation [by] making it descend to earth,” the alchemist himself acquires “the penetrating force of spirit and the fixed force of body” (Newton “Commentary” Appendix B Dobbs Janus 276-277). Male, spirit, and “penetration” occupy one pole of this vertical continuum. The opposite pole is defined by female, body, and “fixed.” If the alchemist does effect the proper transmutation, he will have ”the glory of the world and all obscurities and all need and grief will flee from [him]” (Newton “Commentary” Appendix B Dobbs Janus 276-277). This transformation, however, involves a strange rendezvous, where the poles of the continuum meet in the alchemist, in Newton himself, and his role is not only groom and bride in the marriage of the sun and moon, but minister as well. This requires not only an internalization of the hierarchy but also a systematized violation of the fundamental binary nature of the hierarchy. In terms of the feminine, Newton manages to retain simultaneously the negative associations of the female while recovering her by drawing an essence of purity and perfection from the very

stuff of corruption and imperfection. That place, overtly of the female, contains a necessary ingredient—the "black" and "dark Chaos" out of which "the world was created" (Newton "Commentary" Appendix B Dobbs Janus 277). Importantly, this recovery of the female is not a process of equalization, but the opposite: the female association with corruption, passivity, and inferiority is reinscribed through this marriage, as Chaos is mastered through ordering, and the "glory of the world" and end of need and grief are more on the order of a dowry as reward to the alchemist for taking on and purifying newly acquired chattel.

The transformation of the feminine into an essence of purity—the wife after successful husbanding, to extend Newton's metaphor in the "Commentary" – is best described in his "Praxis," one of the "mad texts" beginning this chapter and Newton's attempt at an alchemical Principia. This work differs from the ones addressed above in significant ways. First, it is entirely Newton's work, and as such, seems arguably more indicative of Newton's personal psychology and "hidden" ideologies. Secondly, the work is intended not to function as mildly interpretative commentary on existing works, but as a grand work of alchemy, a significant extension of the field itself. Thirdly, the text comes at the end of his alchemical work, suggesting a presentation of his culminating thoughts, at least his most sustained effort at synthesis of the work of several decades. Finally, the text is written at a time of "madness." The attribution of "madness" to both Newton's texts and Newton's life at this time doesn't preclude taking the texts seriously as much as it requires a redefinition of serious reading in which comparisons against absolute standards of meaningfulness and sanity are replaced with attempts to infer what standards are suggested if the text were assumed to be "normal."

Given the sole authorship, the intended function, the time of its publication, and its "madness," the following quote from "Praxis," offering up an extended deployment of the trope of the feminine, suggests Newton's sense of the feminine, and category woman, remains problematic:

> This preparation Philetha hints by calling the queen ye daughter of ye water bearer arising out of his loins & says she is contained invisibly in ye water of his silver colored pitcher & arose out of it. & That by a strange metamorphosis done by magical virtue of nature & that after this rise she was naked, that is divested of impurities & beautiful & though a body yet she was all spirit & yet able to endure without hurt ye greatest fires that can be made & in this state it is properly of matter in which vulgar chemists do not work & which is not to be found upon ye earth of the living, tis not the earth wee tread on but that which by sublimation hangs over our heads, and which the wise call terra virginea foliata. (Newton "Praxis" Appendix E Dobbs Janus 297)

In many ways, this quote by itself demonstrates not only major precepts of alchemy, but of Newton's own twist on it. The invocation of "Philetha" as an ancient authority shows that alchemy involves a recall of lost knowledge, not just through reading but through multiple translations, into different languages, into different styles, and into different "experiments," that is, testing the results of a purified translation of a text via actually mixing ingredients and performing catalyzing acts such as heating or burning. Parallel acts of translation occur—of texts and of elements. The "queen" is code not just for a particular element, but also for the spiritual aspect that occupies or enlivens the element.

In this instance that spiritual element is deliberately feminine, daughter of a masculine spirit, and "arising out of his loins" an image reversing the natural state of birth, making of the male a "wombed" Father.

Key here is that what Newton is reporting includes, given the active role of the experimenter's spiritual state in effecting transformations, the parallel actions of his own "self": he, in the mixing of elements, is being "strangely" metamorphosed through magical virtue, and his self, or soul, is naked, divested of impurities. Note as well the seeming contradictions: all spirit yet still a body; she is material yet indestructible, and she is ultimately reduced to pure essence: "matter in which vulgar chemists do not work." Finally, this overtly female aspect of spirit, of both self and elements, is "not upon the earth we tread." Instead, it transcends base earth, the feminized "she" of nature, to be somehow "hung over" our heads—yet still intimately and inseparably connected to the material, as the effort to perform the physical admixture of alchemical ingredients, when it is successful, is involved with a parallel transformation of the alchemist's spirit.

The whole of the image above, significantly, is of the pure virgin—not only intact but beyond the material, invoking the semiotic complement of the unmentionable and unmentioned whore. What seems to be at work in Newton's approach is a consistent deployment of stark binaries, which are then complicated, so that we have, for example, the body opposed to the spirit, and in a larger sense, the female as body opposed to the male as spirit, yet finally mixed—through the art of the alchemist and the "virtue of nature." Nature, the female, is corrupt, yet contains within herself, a transcendent function, only to be released by the alchemist.

The symmetry between the idealized purified feminine in Newton's alchemical writing and what he had and then lost with his mother is unmistakable. He had a mother who was virginalized in a functional sense by the death of his father. Newton's December 25 birthday could not have escaped him, fitting as it does so well with his Arian belief in Jesus as both perfect creation and as immaculate conception. However, this Ideal Pure Woman, resurrected in the trope deployed in his alchemical writings, is killed in reality when his mother not only remarries, and literally falls from the pedestal of chaste purity, but also when she rejects him. Newton's banishment, especially as the "real" child, the one closest to perfect creation, perceived as a shift in attention to her other children, makes his siblings atypical in an Adlerian sense, which sees siblings as models of rivals and cooperators. Instead, his step siblings, as well as his stepfather Barnabas, are solely rivals, and rivals who get the greatest resource of all: mother's love. By not only disembodying woman but by also removing her corruptions, Newton fulfills a set of inter-related desires: he has "woman" without a body that betrays and he has "superiority" as a multiple master, over nature, self, spirit, and the affairs of "Men."

Thus, Newton's mad texts can be read another way: as expressions of psychological and conceptual madness(es). Newton's world was mad in the Adlerian sense in that what he was offered at the beginning of his life was an overdose of relational symbiosis followed by an abrupt withdrawal that led him to codify, in practice and in theory, a scheme of the human involving a sense of self as isolated and discrete. Denied the reality of the flesh of human contact, Newton seemed bound to replace it with an elaborate, if not brilliant, method for transcending the base sphere of the human in order to ascend the heights of the spirit, hovering just below Jehovah. For Newton this

self is a form of consciousness that internalizes extreme forms of hierarchicalized, power-driven social dynamics. In the end, the "self" that emerges in response to Newton's personal experiences and his grapplings with an alchemy informed by Natural Philosophy and whose larger ends are drawn from Arian theology, was, for him, at least, as critical an ancestor in the genealogy of consciousness as the self initially outlined by Plato. That "self," as an exaggerated model of a "modern" self, ironically drawn for Newton from premodern worlds of magic and religious revelation, is a self that is simultaneously mechanical, magical, and spiritual. More than a construct that needs to be "cared for," as Foucault describes the sense of individual being in Care of the Self, it is a construct that is initially corrupt and through systematized policing, is purified to its single essence, and that essence is, as the last quote above notes, an aspect of alchemical "quintessence"—a vital life force that transcends both mechanical processes of nature (though it both partakes of and infuses all things mechanical) and social processes (though, again, it both partakes of and infuses all things social). All the Newtons converge in this attempt to purify the "self"-through- translation—the scientist, the alchemist, the theologian, and most importantly, the little abandoned boy. That this convergence leaves Newton, as Dobbs says, "suspicious, secretive, seldom humorous, indifferent to poetry and music, not friendless but never an easy companion" (Dobbs and Jacob 2) suggests that he goes "mad" within our present frames of what it is to be human and what it is to do science. Read instead as sane comments on the mad world of his strange upbringing and on the mad world of Seventeenth Century tug-and-brutal-tussle with his Royal Society competitors, these texts suggest, that for our much Idolized Enlightenment Genius, brilliant syntheses of disparate fields of knowledge can provide a fine and private place,

but none I think do there embrace. The successful productivity of Newton's effort to bring together disparate systems of representation, evidenced by the significant codification of scientific methodology in the Principia, comes at a cost, one in which the successful scientist succeeds in part through a double failure. The first failure is a failure of the family and then the larger society to provide him with a "humane" model of relationships with others. The second failure is Newton's own, whose genius is in replicating his familial system in social system in which he finds himself, in behavior and texts, and not in truly revolutionizing a community of scholars by creating an atmosphere of cooperation and mutual care.

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CHAPTER FOUR

THE MINTING OF A THEOLOGIAN AND THE THEOLOGIAN AT THE MINT: ALCHEMICAL CHRIST, SCIENTIFIC PROPHESY, AND THE RULE OF GOLD

Betty Jo Dobbs comments in the Janus Faces of Genius that her work on Newton's alchemy is "predicated upon the conviction that to Newton himself all his diverse studies constituted a unified plan for obtaining Truth, and it is organized around a religious interpretation of Newton's alchemy, but more than that, a religious interpretation of all his work" (17-18). In this chapter, I examine specific selections of Newton's theological writings in order to argue Newton's work is not only open to religious interpretation but also involves in practice, whether in natural science, alchemy, or literal scriptural interpretation, conceptually inter-locked forms of "religious interpretation." By religious interpretation I mean that Newton's efforts are all forms of translation that share the larger end of demonstrating a spiritual order characterized by both radical hierarchicalization and systems of "policing" to maintain that rank order. Conceptually, natural science and alchemy are slaved to Newton's Arian theology, so their respective systems of representation are not just influenced by or overlapping with his theology, but instead are subsumed under it. To get at Newton's complex theology, I first examine Newton's form of Arian Puritanism as expressed in his writing, arguing that at the center of that theology is a kind of alchemical Christ, where the trope of transmutation provides a model of a personal "transubstantiation," characterized by a participation in purity and a mastery of flesh. Following that, I analyze Newton's method of translation of sacred texts, arguing that the three characteristics of science informing his Principia—generalizability, simplicity, and verifiability—also characterize Newton's

"science" of prophetic translation. Finally, I show how these principles, from those associated with the alchemical Christ to those associated with scientific prophecy, are realized in Newton's practices as head of the London Mint. There, Newton's complex and idiosyncratic system of systems finds expression in a purifying mechanization of the process of money creation, where "things," from gold coinage, to counterfeits, to employees themselves, are policed to find their proper "place" in the system.

The Alchemical Christ

Newton's form of Puritanism is founded upon principles first advocated by the Fourth Century Monk Arias, who denied the reality of the trinity and argued Jesus was not God but God's first perfect creation. Newton's theological system, though, is more than a simple antitrinitarianism. Across Newton's theological writing, especially his unpublished and unfinished works, Newton returns again and again to the question of Jesus' true status in Christianity. In "Twenty Three Queries Concerning the Word Omoousios," for example, Newton presents a detailed argument against Athanasius' belief in the Trinity, attacking everything from Athanasius' character to the legitimacy of the council of Nicea in determining theological accuracy. In his "Twelve Points on Religion," Newton is even more specific in dealing the ramifications of Athanasius' error and Arius' true understanding of the difference between God the father and God the son:

> 1. The [word] god is nowhere used to signify more than one of the three persons at once.
>
> 2.The word God put absolutely without particular restriction to the son or the Holy Ghost doth always signify the father from one end of the scriptures to the other.

> 3. When ever it is said in the scriptures that there is one God, it is meant of the Father. (References without page numbers come from The Newton Project, unpublished manuscripts translated and published electronically).

In these three points, Newton is in part asserting the sharp division between Jesus and The Father. More importantly, he is also underscoring how language reflects and maintains this division in the scriptures. Jesus is a lower case "god," neither human nor divine yet somehow partaking of both. Newton elaborates on this placement of Jesus as between the Father and the human in point four of "Twelve Points":

> 4. When, after some hereticks had taken Christ for a mere man and others for the supreme God, St, John in his Gospel endeavored to state his nature so that men might have from thence a right apprehension of him and avoid those heresies and to that end calls him the word or *logos:* we must suppose that he intended that term in the same sense that it was taken in the world before he used it when in a like manner applied to an intelligent being.
>
> For if the apostles had not used words as they found them how could they have expected to be rightly understood. Now the term logos before St. John wrote, was generally used in the sense of the Platonists, when applied to an intelligent being, and the Arians understood it in the same sense, and therefore theirs is the true sense of St. John.

Newton is proposing an interesting argument concerning the nature not just of Jesus but of the system of the world itself. God the Father is "supreme:" to maintain that Jesus is supreme is a heresy. However, to maintain Jesus is a human is a heresy as well. Both

heresies involve acts of mistranslation of the book of God. The resolution of these forms of mistranslation is, according to Newton, effected by Saint John when he uses the term logos. Logos, though, means specifically "intelligent being," a being capable of making sense of the world, a human attribute but not human. As Newton adds in point nine of the "Twelve Points on Religion," it was "the son of God which he sent into the world and not a humane soul that suffered for us." A number of important assumptions are underlying Newton's argument: First, Newton is assuming St. John is the preferred source of Jesus information, making of the other gospels mere sidelights, inherently inaccurate because of the multiple perspectives offered. Secondly, language is at the crux of understanding: it serves Newton's purpose here to use the notion of meaning as determined through popular usage, but elsewhere he goes to considerable lengths to demonstrate that language's purity has been corrupted by popular usage. Finally, and the grand assumption giving meaning to Newton's complete scheme of the world, is the notion of severe hierarchy. Jesus is a "servant," he "hath no power in him but what he derives from the Father," he is "dependent upon His will."

This subordination of Jesus to Father is repeatedly emphasized throughout Newton's theological writings, and in many instances forms the theme of the text under development. Newton's numerous lists, in particular, tend to work assiduously at either confirming the subordination of Jesus to the father or at elaborating from that principle, and then outlining a theology. Newton's "Twelve Points" discussed above is perhaps the work most focused on the issue, but in works such as "Twelve Articles on Religion," the sharp delineation between Jesus and the father is repeatedly stated as an article of faith, and is treated as foundational to Newton's theology. What is most remarkable about

Newton's references to Christ is that by far they tend to undermine Christ's status rather than promote him as "King of kings." Jesus is not to be prayed to, Newton states in "Twelve Articles on Religion," nor can he intercede, nor can he do anything but act out on what the father already decrees. Newton in fact rarely even uses the term Jesus, and instead typically deploys "son" or "Son of the Father," again always underscoring a subservient role for the messiah.

What this stripped down Jesus leaves us with in Newton is what I term the Alchemical Christ: an image that is simultaneously of the earth and of the heavens, where the human not so much worships Christ as God as the human actively emulates the realized potential of Christ and transmutes the "self" into a purified essence. The human is twice removed from the essence of God, as people are to emulate the Christ who emulates God. This doubled removal, though, is not an argument for the hierarchy of the Catholic Church. Instead, Newton's twist on Christ provides a place of insertion into the hierarchy that is managed not through adherence to institutionalized religions but through systematic application of translation designed to reflect the God order of the universe, and that order is overtly subordinating. Newton says in his Theological Notebook 2: "The head of every man is Christ, & the head of the woman is the man, & the head of Christ is God. 1 Cor 11.3. All are your's & ye are Christ's & Christ is God's. 2 Cor. 3.22, 23." Here, the placement category woman as the lowliest of serfs is no accident. It directly parallels a system when the feminized earth is the basest, most corrupted "text" and the hypermasculinized heavens are the highest. Additionally, the "head" image conjures up the trope of the body; the female here is the lowest body, double–headed by the man, as both symbol of intellect and of maleness. The man, as the next step up on the

ladder, is double-headed by Christ, ruled by both Newton's sense of logos and the mind violently separated from body. Christ is, after all, a strange symbol of being born through violent death, a model of purity attainable through agony.

To get at this concept of the Alchemical Christ, however, requires outlining the overall structure of Newton's scheme as presented in his theological writings. The Christ that emerges from Newton's writing is characterized more by what he isn't—especially in terms of traditional Christianity—than what he is. What this Alchemical Christ isn't is a figure equal to or cosubstantial with the father; he isn't a figure then to be worshipped, and he isn't "God." In short, this Jesus is more like us than a supreme being, and what he is, after isolating what he is not, is a model of how to both participate in the purity of God while also mastering the flesh. If one does this, one doesn't become God but instead a Lord—a higher up on the hierarchy that overlays the clockwork universe. These two concepts—participation in purity and mastery of the flesh—are the two faces of the Alchemical Christ. Additionally, they are expressions of the two poles of the impure to pure, body to spirit, earth to heaven continuum. Christ, in his complicated role as the transmuted, is a bending of the continuum:

> Who is the Image of the invisible God, the first born of every creature. For by him [God the Father] were all things created that are in heaven & that are in earth visible & invisible, whether they be thrones or dominions, or principalities or powers, all things were created by him & for him. And he is before all things & by him all things consist. And he [Christ] is the head of the body the church, who is the beginning, the first born from the dead; that in all things he might have the preeminence. For it pleased the Father

> that in him should all fulness dwell Colos 1.15. – In him are hid all the treasures of wisdome & knowledg, – For in him dwelleth all the fulnes of the Godhead bodily. (Theological Notebook 2)

Here, Christ is described as "the first born of the dead" which results in his "fullness" and "preeminence" and hidden source of "all treasures of wisdom and knowledge." Again, he is replete with seeming contradictions: an "image of the invisible," a thing "born of the dead" are both more apt descriptors of a vampire than humanized god. This Christ, after all, as Newton maintains, we are to emulate not worship: it seems much to ask us to be images of the invisible and to be born of death. Nonetheless, these images are also images of transformation via admixture of opposites. They are sensible as a model of process when paralleled to the principle of alchemical transformation. Consider this description of transmutation from Newton's "Commentary on Hermes:"

> This it ought to first be cleansed by separating the elements…without violence, and by making the whole material ascend into heaven by sublimation and then through a reiteration of sublimation making it descend to the earth: by that method it acquires the penetrating force of spirit and the fixed force of body. Thus will you have the glory of the whole world and all obscurities and all need and all need and grief will flee from you. For this thing, when it has…ascended to heaven and descended into earth becomes the strongest of all things. (276-277)

This description parallels Christ's transformation via death and resurrection, in both process and product. Christ embodies spirit, Christ descends to the earth and ascends to

heaven, and Christ is "purified." Not insignificantly, that purification results in raw power—the "strongest of all things."

Christ's Kingdom may not "be of the earth" in this scheme, but his power is here, and the one significant power Newton gives his Christ is the power of Judgment. In Newton's Theological Notebook II, he describes the role of Christ as executer of judgment, while also reinforcing that the authority for judgment is yet another power not intrinsic to the son but derived from the Father:

. For as the Father hath life in himself, so hath he given to the son to have life in himself, & hath given him authority to execute judgment also — I can of my self do nothing; As I hear I judg, & my judgment is just becaus I seek not mine own will but the will of the father which hath sent me. Iohn 5.17.

One of Newton's rhetorical means of supporting these two aspects as the correct understanding of theology is his repeated identification of the two most important commandments: the first and the "eleventh." He begins his short unpublished work "Irenicum" with a bald assertion of these two commandments' primacy:

> In matters of religion the first & great Commandment hath always been: Thou shalt love the Lord thy God with all thy heart & with all thy soul & with all thy mind. And the second is like unto it: Thou shalt love thy neighbour as thy self. On these two hang all the Law & the Prophets. Matth. 22.27. And the Gospel is that Iesus is the Christ. Whoever beleiveth that Iesus is the Christ is born of God, & every one that loveth him that begat, loveth him also that is begotten of him 1 Iohn 5.1.

Three "Newtonian" rhetorical moves characterize this passage, and are evident across the bulk of his theological writings. First, in many instances he structures his discourse in a rationalistic form, in that he tends to state one or two central claims early on, and then methodically backs them up as he continues. The quote above begins the Ireniucum, and functions as its thesis in that the rest of the discourse expands on the two "great commandments." That is, Newton's overall discourse form is rationalistic, despite any inherent irrationality associated with theological reasoning and/or expression via text. Critical to Newton's rationalism, however, is a consistent reductivity. For example, in "A Short Schem [sic] of the True Religion," he specifically collapses the rest of the commandments into the first and eleventh: "The first is enjoyned in the four first commandments of the Decalogue & the second[love others as self] in the six last." Secondly, his "evidence" consists primarily of quotes and paraphrases taken from the Bible and other ancient sources. However, he deploys them in an almost duplicitous manner. They seem to speak for themselves, and, as Mandelbrote notes, from the beginning Newton's theological writings were highly criticized for selectivity of quoted material, misuse of translations, and semblance of erudition (416). His religious texts at times read as a Benjaminian Arcades project, with fragments from a vast array of sources deployed. Unlike Benjamin's approach, though, Newton doesn't free his material from context, allowing for novel interpretations, but instead recontextualizes the passages, implicitly arguing throughout, and explicitly in the case of his works on prophecy, that he is offering the only valid context.

Newton doesn't restrain his "rational" discussion to identification of the two most important commandments in "A Short Schem [sic] of the True Religion."Rather, he

seems more interested in elaborating on how the human is to behave in light of the primacy of these commandments:

> Repentance & remission of sins relate to transgressions against the two great commandments. We are to forsake the Devil, that is all fals Gods & all manner of idolatry this being a breach of the first & great commandment. And we are to forsake the flesh & the World, or as the Apostle Iohn expresseth it, the lust of the flesh the lust of the eye & the pride of life, that is, unchastity, intemperance, injustice, covetousness, pride, & ambition, these things being a breach of the second of the two great commandments.

Sin, in Newton's system, is an identification of transgression of the two commandments. Idolatry, as the quote notes, is the worst transgression. Idolatry here, however, involves more than simple worshipping of golden calves: it includes any placement of any person, thing, or process on par with God, even to the extent of treating a saint, king, or even Jesus himself as a mediator between us and God. Jesus, in particular, is almost a minefield of potential transgressions of the first commandment, as Newton demonstrates in the "Irenicum" below:

> And tho we are to worship him, yet we are to do it without breaking the first commandment there is to be (in our worship) no other God but one. For tho there be that are called Gods, whether in heaven or in earth (as there be Gods many & Lords many) yet to us [in our worship] there is but one God the father of whom are all things & we in him, & one Lord Iesus Christ by whom are all things & we by him. 1 Cor. VIII.5. [Newton's

> underscoring]We are not to give the worship of the father to the son nor the worship of the Son to the to the father but to worship each with that worship which is proper & peculiar to him. We are not to invoke the Son in the name of the father but on the contrary to invoke the father in the name of the Son. We are not to give glory to the father because he was slain for us nor to the son because he created all things, but on the contrary we are to conform our worship to the dictates of our Creed. We are to worship the father as God almighty maker of heaven & earth & the son as the Lord Iesus Christ who was slain for us & hath redeemed us with his blood.

Newton is underscoring more than a sentence here: he is asserting a number of concepts foundational to his theology. First, the world(s) do have "Gods many & Lords many." Their reality isn't at issue: what is at issue is worship, that is, who and how we are to acknowledge those as "over us." Newton's words suggest sharp demarcations: the role of the father as source of all and son a mere expression of that source is demanded by Newton's insistence on separating out the respective dues to be given each. To mix the worships—to even thank Jesus for creation—is not just a sin but a major transgression. Such a mix up obviously wouldn't diminish God, but what is threatened is the hierarchy, especially the very top of the rank order. Secondly, worship in this scheme is a set of practices that always in part reaffirms a certain and signal hierarchical relationship in which the son, as Newton says elsewhere, "submits his will to the will of the father, which would be unreasonable if he were equal to the father" ("12 Points").

The larger question to be answered when looking at Newton's concept of the Alchemical Christ is notwhat Jesus is or even what God the Father is but what we are. Julia Kristeva, in Crisis of the European Subject, provides a provocative argument concerning the human consequences of Protestantism's understanding of the relationship between God the Father and son:

> God is threefold in Orthodoxy, but not in then same way as in Catholicism: the Holy spirit proceeds *through* the son for the orthodox (per filium); the Holy Spirit proceeds from the Father and Son for then Catholics (filioque). While this "and" puts father and son on equal footing and prefigures the autonomy and independence of the person (that of the Son, as well as the believer, which opens the way to Western individualism and personalism), the Orthodox "through" suggests a delicious but deadly annihilation of the Son and the believer.
>
> The Father's omnipotent authority is inalienable…the father is divinity-origin. The son is his servant and assistant who by means of this servitude—"through" nonetheless raises and deifies himself. Subordinate and godlike at the same time, the Son (and with him the believer) is caught in an exquisite logic of submission and exaltation that offers him the joys and sorrows intrinsic of the master-dialect . . . . (138-139)

This "delicious and deadly annihilation" of the believer, according to Kristeva, sets the stage for a conception of a person either absorbed in the "adoration-feminization of the Son" or involved in destructive revolt, as the father is so far removed from the human by the subjectification of the son, leaving the "incommensurable divine authority" beyond

discussion, criticism or negotiation. In Newton's scheme, more than in the protestant Orthodoxy that Kristeva discusses, the issue of further remove from God is exacerbated by the denial of the trinity, with the concomitant implicit and conceptually entangled assumption of radical hierarchicalization. If Kristeva's general thesis is accepted, that the general Protestant theology's change in depiction of the Son and Father relationship invites a psychological engagement in the joys and horrors of the "Master-slave dialect" then Newton's Alchemical Christ invites an exaggerated response, where the Christ image is denied even the vestiges of the godhead retained in Protestantism's change in conception of the trinity. Even Christ, the purist of the pure, is overtly submissive to the Father, and that only after the violent transformative process of death and resurrection. The human is lowered further in Newton's scheme, prone not only to violate the second commandment, but more dangerously to violate the first: to confuse the vertical relationship structure inherent in the world by worshipping the false idol.

The Alchemical Christ, as I have traced, provides a model of not only a pure creation but a method of personal, even psychological, transformation—a transmutation from impure false-idol-worshipping sinner, to pure clearly-cognizant-of-rank-order "saint," or at least some sort of Lord over lesser beings. This transformation, in part, is effected by systematic "policing" of transgressions. Consider the following from Newton's Fitwellian Museum Notebook:

Threatning my father and mother Smith to burne them and the house over them 13

Wishing death and hoping it to some 14

Striking many 15

Having uncleane thoughts words and actions and dreamese. 16

Stealing cherry cobs from Eduard Storer	17
Denying that I did so	18
Denying a crossbow to my mother and grandmother though I knew of it	19
Setting my heart on money learning pleasure more than Thee	20
A relapse	21
A relapse	22
A breaking again of my covenant renued in the Lords Supper	23

The careful cataloguing of Newton's sins, reminiscent of Dafoe's Crusoe's cataloging of omissions and commissions on the isle, is telling on a number of levels. First, this listing of sins before and after "Whitsunday 1662," reveals a twin obsession with both self-monitoring and precise "accounting for." The long list of sins Newton carefully chronicles is followed by a detailed ledger of his lending practices while at Cambridge as an undergraduate, showing that Newton is not only transgressive in his own eyes but more critically engaging in a form of textual purification, as the act of listing is godlike in its precise accounting for transgressions. In the Notebook Newton parallels this spiritual accounting with a literal accounting—his lending of money, at apparently usurious rates, to fellow students at Cambridge. Secondly, the sins listed, from avarice, to lying, to theft, to wishing the death of others, are one constellation of transgressions subsumable under the second commandment. Other sins listed reveal Newton's early obsession with the first commandment. For example, the first nine sins on Newton's list all involve doing something untoward on "Thy day," such as "making a feather," "eating an apple," and even "squirting water." In all, 15 of the 49 sins listed involve some sort of a transgression against God himself, by violating some aspect of the first commandment. At least ten

more of the sins listed involve some kind of failure to maintain a proper attitude towards God, whether by not praying or failing to worship correctly. In this mechanized listing, the more horrifying sins, such as his desire for the death of others, seem praised with faint damnation, as they get an equal and interchangeable number with all the rest. Much has been made by a variety of theorists about Newton's desire for other's death as a sin listed, but none have commented on the overall trend of Newton's sins, which by their particular selectivity support an early at least implicit sense of the sins suggested by his later development of the Alchemical Christ: a notion of the human as placed by God in a subservient rung on the ladder of purity, where violations of the essence of purity—God the Father Himself—are worse than violations of people's rights, though attendance to both sets of acts is required for transmutative ascendancy towards the Pure.

Scientific Prophecy

The Alchemical Christ, however, constitutes only part of Newton's complete theological scheme of the world. If Newton's writing of the relation of the Father to the Son reflects his Arian puritanical view of an individual human as a base element capable of transmutation through unmediated emulation to a level near but always below God, then his writings on prophecy reflect transmutation of the history of entire cultures, only with the direction reversed, as Newton's history of the world is a history of descent into corruption. The history of the world, starting with the biblical past of Abraham and Noah and leading up to Newton's present, is in a larger sense a history of Idolatry, in which God the Father's stratified system of creation continually lends itself to people mistaking aspects of the world, such as kings or processes of nature, with what they really demonstrate: God the Father as Lord Creator and Protector.

Newton's approach to ancient texts in general, and specifically certain scriptures such as St. John's, is to employ a "scientific" method of scriptural interpretation, where rules of translation consonant with his Natural Philosophy's rules of consequence guide the translator/interpreter's task. This science in his theology could be, and historically has been, treated as an obvious and for many absurd extension of Newton's science into another area of inquiry. However, Newton seems to have applied a remarkably similar set of rules to the set outlined in the Principia in his writing on scripture long before he applied the rules to Natural Philosophy. The question as to which occurred first–the rules of consequence in the science and then applied to the system of prophecy, or the rules of consequence in the system for prophecy and then applied to the science—has some bearing on the issue of Newton's overall system of systems. Simply, the view of Newton as scientist who dabbled in theology—and as such, not insignificantly, as model of modern man—is not supported by his own texts' chronology. Maurizio Mamiani addresses the issue in the Cambridge Companion to Newton:

> According to Frank Manuel, the interpretative rules of the Apocalypse were a copy of the *Regulae Philsophandi* of the *Principia,* but this conclusion is chronologically impossible—the rules of the *Principia* were written almost forty years after those of the *Trattato.* Obviously the inverse must be the case. But how can it be that the Rules of Reasoning of the *Principia,* considered the foundations of the experimental method, are a copy of the rules of the Apocalypse? If we bear in mind Newton's intellectual development, the answer is clear. Even before he was

> concerned with interpretation of the Apocalypse, Newton had developed many of his methodological ideas. (396)

Mamiani's "clear answer" is anything but. Notice the set of rhetorical moves he employs in the quote above. He first refutes Manuel's assertion that the rules were first developed in Newton's science, noting that the *Trattato sull'Apocalisse*, a 1660's monograph concerning systematic interpretation of the Apocalypse, preceded the authorized version of the Principia by four decades. Then Mamiani reaffirms Manuel's thesis by noting vaguely that Newton "had developed many of his methodological ideas" prior to his addressing of the problem of scriptural interpretation. Mamiani, it seems, is both too smart to accept a violently inaccurate chronology and too committed to the assumption that Newton's primary frame was "science."

The simplest explanation for rules of consequence, that is, the scientific method, appearing first in his Prophetics and only much later in his Natural Philosophy, is that Newton, as first and foremost a theologian, developed a set of procedures for structured analysis of religious texts, and then applied those same procedures to the "text" of nature. Newton's method of scientific prophecy in this frame assumes analysis of scripture as Newton's primary model, with the worlds of self (alchemy) and nature (Natural Philosophy) as subsets of inquiry. Just as the lawfulness of nature is revealed in the structured reading of the book of nature, so, too, is the lawfulness of God the Father revealed in a structured reading of scripture. The quest for Newton is not just determination of order but more precisely the application of central principles of ordering to reveal the orderedness of things. Cohen claims Newton is arguing from design, but Newton's own efforts suggest he is more arguing *to* re-present Design, giving, as Jesus

did, a revelation of aspects of the Father, an act of both proof of God and worship. God, in this scheme, is not rhetorically but necessarily "unattainable," as the one who both designed the order and introduced order in the first place is logically outside the system set in motion, as the creation is always sharply delineated from and subservient to the creator. However, unattainable does not preclude partial discovery, or in Newton's overall scheme, more aptly "re-membering." To "re-member" this formerly known truth is to apply a systematic and "scientific" way of decoding texts. In this system of representation, Newton directly equates hypothesis with "signification:"

> The Rule I have followed has been to compare the several mystical places of scripture where the same prophetic phrase or type is used & to fix such a signification to that phrase as agrees best with all the places, & if more significations then one be necessary to note the circumstances by which it may be known in what signification the phrase is taken in any place & when I had found the necessary significations to reject all others as the ofspring of luxuriant fansy. *ffor no more significations are to be admitted for true ones then can be proved* [italics added]. ("Draft Chapters of a Treatise on the Origin of Religion and its Corruption")

Here, Newton is outlining the crux of his system: the fixing of significations in the text, that is, determining the perfect meaning of the word written. Not surprisingly, Newton's method is empirical; at least to the extent that he induces a general rule of semantics from a variety of instances. These significations, like the hypotheses, are not to be feigned: significations non fingo, Newton seems to be claiming, asserting a

comparable demand for proof as he demands in the Principia. Here is an aspect of Enlightenment science clearly stated: strict verification, complementing the rules of simplicity and generalizability. Verification, proof, in decoding the Bible, however, is a different sort of enterprise for Newton the Arian than for Newton the natural philosopher;

> I have not feared sometimes to call in to my assistance the eastern expositors of their mystical writers (I mean the Chalde Paraphrast & the Interpreters of dreams) following herein the Example of Mr Mede & other late writers. ffor the language of the Prophets being hieroglyphical had affinity wth that of the Egyptian Priests & eastern wise men & therefore was anciently much better understood in the East then it is now in the west. I received also much light in this search by the analogy between the world natural & the word politique. ffor the mystical language was founded in this analogy & will be best understood by considering its original. ("Draft Chapters of a Treatise on the Origin of Religion and its Corruption")

This quote is rich in revelations of Newton's method of biblical text purification. Newton seemingly violates empirical science's demand for an appeal to observations of things in themselves by asserting appeal to ancient authorities, yet note his reasoning: he seeks analogy between what occurs in "the world natural" and " the "world politique." He is approaching these texts empirically; his method looks to simplify the message across the texts by verifying that simple explanation with demands for "proof" in the text. Additionally, he is operating from the outset with an implicit sense of generalization in that the simple and verifiable "essence" of God's message, truth itself, is found across

cultures, epochs, people's, and even religions, with those texts closer to the source, to the mystical language which all once spoke, just as worthy objects of study as contemporary Christian texts, if no more so. Valid significations, those which carry the analogy between the world of nature and the world politique, that is, between the world of nature and the world of the human, are valid because of the way god designed the world, a world only made intelligible through language. In the beginning, Newton maintains, a near perfect isomorphism between language and God's laws. Jehovah, in this scheme, cannot be spoken because of the equation of signifier with signified—the act itself makes of the speaker a kind of creator of the creator of all things. Instead, necessary approximations are required, close to, ever mindful of God, but still removed. Closest to God is the frame of nature itself—the temple of the natural world, as Newton calls it. To recognize it, as in recognizing the simple, verifiable, and generalizable beauty of the movements of the spheres, requires the inscribing of it. God, in this scheme, was initially available in this remote fashion, when a common mystical language unified the world. However, the very process necessary to prevent re-placement of God at the top, a submission-as-worship that first involved seeing God in the symmetry of nature, especially the heavens, seems to invite more distancing, and hence a double fall from grace—we as people move farther from recognizing God and our texts parallel this fall, ending up, by Newton's time, as evidence both of hidden truths of God and not so hidden proofs of more arbitrary relations between the signified and signifier.

This strange system, in which language is simultaneously truthful and deceptive, is understandable if one accepts the premises that God is both over—and outside of—while also thoroughly implied by the frame of nature. The move here of both people and

language is literally and figuratively downward. For Newton, this descent, this process of corruption of language and with it, the corruption of entire cultures, occurred in three phases:

1. Primeval state, where symmetry of heavens demonstrates god's perfection
2. Secondary state, where celestial bodies supplant god, and are idolized
3. Tertiary state, where dead are associated with celestial bodies, and dead are idolized. ("Draft Chapters of a Treatise on the Origin of Religion and its Corruption")

What is increasingly lost over time is a true logos, a language that makes clearly intelligible the truth of God found in the symmetry of the world. What causes this is the pesky "world politique:" the human, over the eons, behaviorally and linguistically shifts worship from God, to the heavens, to politics, at each step erasing the true order of things while retaining a sense of the authority derivable from that divinely mandated order. Language in sacred texts, such as The Apocalypse, has undergone the opposite of transmutation: from simple purity of penultimate perspicuity to basely complex corruptions of meaning. Along with that descent into plurality, both of languages and of cultures, comes a loss of rationality, and with it, an inability to "know" God: "So then the first religion was the most rational of all others till the nations corrupted it. ffor there is no way (without revelation) to come to the knowledge of a Deity but by the frame of nature" ("Draft Chapters of a Treatise on the Origin of Religion and its Corruption"). This statement is key to Newton's theology, in that here he identifies the ideal religion as the most rational and identifies two means of knowing God. Critically, he is stating the primary motive: to establish an epistemology that allows for accurate re-presentation of

God. That God, as Newton repeatedly notes in the "General Scholium" of the Principia, is "always and everywhere" while also not directly involved in things. That multiplying across time of languages, all drawn in Newton's scheme from an uber mystical language, is just a part of the corruption: the real babble here is the babble emerging from a language with an unmistakable and perhaps even co-creative direct link between signifier and signified to an increasingly leveled relationship, where signifiers refer to other signifiers which the provide the signified, with the final product, the text before Newton, replete with indirect connections.

The best way to approach these texts, Newton notes, is in identification of common terms and their translated meanings across texts, followed by testing those terms against history:

> For there is no better way of interpreting scripture then by comparing the parts of it & reconciling all the synchronall & all the analogous parts of prophesy which can be reconciled without force. Tis certain that the same things are described again and again in prophesy: And all the descriptions of one & the same thing must be conjoyned that they may interpret one another & supply one anothers defects & joyntly make one complete description which cannot be misapplied to history. And those interpretations are always to be preferred which reduce the parts of scripture to the greatest consent & harmony. ("Draft Chapters of a Treatise on the Origin of Religion and its Corruption")

The sacred texts, as Newton would have it, parallel, and to a degree compound through increasing invitations for mistranslation, the human's headlong falls from grace across

history. Simultaneously, in the case of the Apocalypse of St. John, the text, when purified according to the principles of empirical science, "predicts" the history of that fall, as well as the human's violent redemption in the end of days.

Newton's application of a "scientific" method raises a critical question: where does Newton derive the authority for the method itself? The easy answer is that he has found the rules of reasoning, the application of Enlightenment science's primary characteristics of simplicity, generalizability, and verifiability, so effective in translating the book of nature that their extension into analysis of the book(s) of God makes a sleepy kind of sense. However, that claim seems less defensible when the chronology of application, as discussed earlier, is considered. Simply, Newton seems to be applying his scientific method as a theological method long before he applies it as a scientific method. If the Rules are not determined by a natural philosophic epistemology, then from where does he derive the epistemological authority for those rules? The key to understanding the source of these rules validity for understanding both texts and the natural world is cryptically revealed in Newton's "General Scholium" of the Principia:

> He rules all things, not as the world soul but as the lord of all. And because of his dominion he is called Lord god *Pantokrator.* For "god" is a relative word and has reference to servants, and godhood is the lordship of God, not over his own body as is supposed by those for whom God is the world soul, but over servants. The supreme god is eternal, infinite, and absolutely *perfect being; but a being, however perfect, without dominion* is not the Lord God . . . .The lordship of a spiritual being constitutes true god, a supreme lordship a supreme god, an imaginary lordship an

> imaginary god. And from true lordship it follows that the true god is living, intelligent, and powerful. . . he is eternal and infinite, that is, he endures from eternity to eternity, and he is present from infinity to infinity, he rules all things, he knows all things that happen or can happen. . . . He endures always and is present everywhere, and by existing always and everywhere he constitutes duration and space. Since each and every particle of space is *always*, and each and every indivisible moment is *everywhere*, certainly the maker and lord of all things will not be *never* and *nowhere.* [italics Newton's] (940-941)

This long quote is tricky to interpret, to say the least. First, Newton is revealing that he is anything but a deist: his God is neither oversoul nor the "crossed out" God as Bruno Latour characterizes the eventual status of God in the emergent Enlightenment Constitution (We Have Never been Modern). Instead, Newton's God is directly involved, as a true lord must have dominion—and as Newton states in a subsequent passage, "not only virtually but *substantially*.... In him all things are contained and moved" though "he does not act on them nor they on him" (941*).* This scheme is curious—on the one hand a lord must have dominion, or is not a true lord, on the other hand, this lord of lords doesn't act on things not they on them. Newton's resolution of this seeming contradiction is as elegant as it is *sui generis*: God's seeming absence, suggested by the denial of his direct intervention, is really a higher order presence: God is only outside of the system in the sense that a king is outside the kingdom he rules. In reality, he constitutes time and space themselves, providing reality's "constitution"— the rules of design. This constitution is literally enforced: Newton has inertia, gravity, and acceleration all as "forces" in the

Principia, a definitional problem for scientists, as it conjures up the occult and Scholastic purpose. Cohen goes to remarkable lengths to argue Newton's use of the term force never indicates anything but either a mathematical construct of a kind of semantic placeholder in the case of *in situ*, the Latin term Newton deploys when writing of the "force" of inertia ("Some Fundamental Concepts" 96-107). However, when describing, always and everywhere covertly in Newton's case, God's direct mastering of things, of nature, "force" is not only consistent but particularly applicable. The power of God, in this constitution, must be pervasive and direct, while also not things-in-themselves. The rules of that constitution, in which both transcendence and immanence characterize this Supreme Being, are the rules of consequence themselves. Newton's God is simple—a basic essence constant across all worlds, natural, alchemical, and theological. Additionally, Newton's God is generalizable—across time, space, texts, and transmutable souls, if transmutation is taken to be also a process of simplification, generalization, and verification. Finally, Newton's God is verifiable, both in the sense of discernible in all areas of inquiry, when simplicity and generalizability are applied, whether in designing a grand system of systems for nature or in designing a system of analysis of ancient texts, and in being truth itself. Simply, the Rules of Consequence are the highest attributes of God: not God himself, but God's commandments for (and ongoing commanding of) creation, in a manner. By following those rules, whether as scientist, alchemist, or textual hermeneutist, one reaffirms God's status as Pantokrator—"universal ruler"—in the manner of a servant who carries out the orders of the master, and the primary order—the first commandment—becomes a dictate for re-affirming the order of the world. Even Jesus' mandate—the "eleventh commandment"—is an expression of simplicity,

generalizability, and verifiability, in that Jesus provides a simple rule containing all the specific rules of the Old Testament that can be generalized across situations, making of Jesus realized Truth itself, the highest material expression of spiritual lawfulness.

If God is for Newton, as I am maintaining, a being characterized by simplicity, generalizability, and verfiability, then an important question arises: why doesn't Newton say so directly? Two answers suggest themselves. First, Newton's theology is a heresy: for his system to work one must accept that the trinity is a corruption, something Newton cannot assert without serious consequence from the religious authorities of his day, such as those who provide him a sinecure at Trinity College. Secondly, Newton cannot admit directly that the basis for empirical science is derived from a Scholastic epistemology, in which a set of assumptions about God are treated as the starting point and everything is made to fit those assumptions. Such an argument requires reinstilling purpose in things and people, the very concept that most of Enlightenment scientists, from Descartes to Bacon, to Locke, to Hooke, assume to be the basic error of the late medieval writers.

Instead, Newton creates what appears to be three different "authors" writing three different sets of texts—natural, philosophical, alchemical, and theological. Each set appears to operate with similar "scientific" methods, again inviting that irresistible image of Newton the scientist dabbling in sorcery and religion if one is to find any consistency in Newton's thoughts while also valorizing him as at least a deliberate progenitor of secularism. However, Newton's own theological efforts—not to publish but to write the activities of his studies—are better understood as the centerpiece of his overall inquiry. The ends of that inquiry—to know God—is also to define a subject position, a self-in-

relation-to, in many ways for Newton a part defined by its relation to the mathematical divine whole.

Were a theorist to come upon only Newton's theological writings, and somehow be unaware of Newton's other work, a very different Newton would probably emerge—an impediment to science, on par with contemporary creationists, only "scientific" to the extent that he invokes the authority of empirical method while all the while having a secret dogmatic agenda. That Newton, of course, is unsustainable due the reality of his scientific texts and his alchemical texts. Instead, reading across the texts in search of the author(ity) behind them all, with the basic assumption from the outset that knowledge of the divinity is both the common end and the foundation of the whole system of truth-validation, the Newton emergent is much more complicated, a crowd almost. Yet that crowd, I maintain, speaks its truths in one voice, the voice of simplicity, verifiability, and generalizability, the voice authorized by the Lord Pantokrator himself. As a potential Alchemical Christ, Newton is positioned to both recognize corruption and set in motion processes of purifications. As privy to scientifically validated truth of prophecy, Newton is positioned to reaffirm the true status of the "body politique" in the hierarchical scheme of Jehovah's things. And as consummate scientist, Newton is positioned to recognize, encourage, and take advantage of his understanding of the divine machine nature of the world.

The Rule of Gold

By 1695, Newton seemed to have it all: a worldwide reputation as the Enlightenment science authority, guaranteed luxurious lodgings and per annum from Cambridge, and freedom to pursue his lofty studies on the heavenly spheres with minimal

distraction. Certainly, any Enlightenment genius worth his or her salt would have to provide a compelling explanation for giving up this life of relative material and egregiously contemplative intellectual luxury, especially one with Newton's much advertised aversion to the life of the body as opposed to the mind. Additionally, Newton's behavior up to that time suggests anything but a love of social interaction with his intellectual "peers."

Yet Newton leaves his familiar quarters at Trinity for the last time in 1696, having managed to secure a supervisory position as Warden at the London mint. Biographers have responded to Newton dramatic departure from the college in a number of ways, ranging from speculations as to his termination of his alleged homosexual relationship with the fop Fatio (White), to a need to change his life after the breakdown of 1693 (Christenson), to his desire for power in a more material venue than academia (Westfall 219-221), to Newton's answering the "crown call for guidance from imminent citizens" (Gleick 158-159). Westfall, in particular, seems to go to the greatest lengths to provide a rationale that Newton's decision, to take on, as he calls it, "A relatively minor bureaucratic post in London:"

> What attraction would hold him in Cambridge? Certainly not the intellectual community; and if a desire for such played any role in his decision, it must have tipped the scale decisively for London. Cambridge's advantage for him had always been the uninterrupted leisure it provided for him to pursue his studies. As he felt his creative energy subsiding, that advantage had evaporated. Indeed his failures in the 1690's may well have

> driven him to escape from unproductive leisure into concrete activity. (219)

Westfall hides a number of critical assumptions in this quote. First, he assumes that Newton felt he was unproductive in the 1690's, the time during which Newton both worked assiduously on the alchemical "Praxis" (see Chapter Three) and had his "Dark Year" of 1693. This assumption is predicated on a belief that Newton, as Westfall notes elsewhere, felt the alchemical studies had been a blind alley of inquiry, and had served as invalidation of alchemical epistemology—and by extension—a validation of "scientific" epistemology. As Betty Jo Dobbs maintains, textual evidence suggests exactly the opposite: Newton never gave up on alchemy as a system of representation, only on his full mastery of the system. Also, Westfall is asserting that Newton's "creative energies were subsiding." If activity both intense and innovative in an area is a creative energy, then Newton's behavior at the Mint, where he revolutionizes the Mint's working, both in bureaucratic structure and efficiency, demonstrates his creative energies were anything but on the wane. Instead, they more accurately seem redirected, into the "concrete activity" Westfall notes. However, for Westfall, who glosses over the contradiction of asserting "subsiding creative energies" while providing a depiction of a man as blazingly obsessed with running the mint as writing the Principia, Newton's behavior is treated as an expression of a thinker whose better days are past him, and who is left to pursue the deserved material rewards his genius deserved.

I suggest another interpretation, one that treats Newton's decision to go to the mint not as reflective of exhaustion of his intellectual studies but as logical extension of them, where the Mint days are not an example of an old academic's exercising of his

prestige in order to get a cushy berth. Rather, Newton's mint work is a direct application of the understanding he has acquired of the books of nature, self, and God. Each of these books, Newton has discovered, require translatory acts of purification, and must be systematically policed in order to be understood. Yet, that understanding is not knowledge for knowledge's sake. As Newton notes at the end of the Opticks,

> and if Natural Philosophy in all its parts, by pursuing this method, shall at length be perfected, , the bounds of moral Philosophy will also be enlarged. For so far as we can know by Natural Philosophy what is the first Cause, what power he has over us, and what Benefits we receive from him, as well as that towards one another, will appear to us by the Light of Nature. And no doubt, if the Worship of false idols had not blinded the Heathen, their Moral Philosophy would have gone farther than to the four Cardinal Virtues; and instead of teaching the Transmigration of souls, and to worship the Sun and the Moon, and dead heroes, they would have taught us to worship our true Author and benefactor, as their ancestors did under the government of Noah and his sons before they corrupted themselves. (Opticks. 405-406)

In many ways, this quote, taken from Newton's last major publication in Natural Philosophy and published in 1704, when Newton is master of the mint, most clearly articulates the direct connection between Newton's Natural Philosophy and his theology. Most interesting is his conclusion—that if his Method is followed, the knowledge gained will suggest application into Moral Philosophy—the text of the human itself. Note as well what he believes it will accomplish—a government akin to that of Noah's, one whose

main justification is to determine proper worship, which for Newton is always and everywhere a dispelling of false idols. The structure of nature itself is, for Newton, evidence of God's power over us. Given what I addressed earlier, namely that Newton's overt work in theology demonstrates both what I call the Alchemical Christ, which provides a model of purification via violent transformation of the flesh, and a "scientific" method of translation, which involves removing corruptions the opposite of sciences' three characteristics (specifically, impurities of complexity, locality, and construction), then what Newton implies for moral philosophy is a model of a single "knowledgeable" individual, approaching Christ in purity, who, in the world politique, is capable of machining the social so that it fits God's design.

Instead of departing from his diverse yet systematically inter-locked "readings" of the books of nature, self, and God, Newton is positioned to bring those studies' method and laws to bear on another text—the body politique. At this point in his life, Newton is more than prepared to translate another corrupt text. Seemingly serendipitously, one substance important to natural philosophers, alchemists, and Bible translators alike—gold—is what is at issue in the workings of the mint. For the natural philosopher, gold is a material embodying purity. For an alchemist, gold is a substance that demonstrates a transmutation of a soul into a more pure entity. For an Arian theologian, gold in God's texts represents purity, lordship, and high status.

Seen as a pulling together of all these three senses of gold, Newton's motivation to work at the Mint seems neither reducible to a change of vocation nor an attempt to gain wealth, but rather a quest to scientifically transmute the workings of the mint by applying God's commandment to determine proper worship. Rivaling nature's, the self's,

and the scripture's degrees of corruption, the London mint is in a dire state when Newton begins working there. From the method of working, to the workers themselves, to the true status of the warden and the mint in the larger government, the mint at all levels needs "purification." Westfall writes:

> Crises wracked the institution… Indeed, the mint was an institution within an institution within an institution, all three of which faced crisis. The recoinage engaged every pinch of energy at the mint. The treasury, of which the mint was a very minor department, devoted equal energy to devising temporary expedients and new machinery to cope with overwhelming financial needs caused by the war with France. The English state and the revolutionary settlement it embodied balanced precariously on the Treasury's efforts. In 1696, it was not clear that the financial demands of the war would be met. If they were not, and national bankruptcy ensued, the revolutionary settlement would undoubtedly collapse before a second Stuart restoration. (221)

Clearly for Westfall, not only was the state of the mint precarious, the entire government was at stake. Indeed, the order of the "world politique" was threatened by the mint's deplorable state. Enter Newton, armed not only with a method and a metaphor—science and the machine— but also a higher calling: re-cognizing and then manipulating God-the Father's laws, puritanically reasserting the order as a conscious elaboration of God's intention. Like Jesus, Newton, by looking through the frames of "revealed" nature and "naturalized" revelation, has been given the power of exercising judgment over people and things. Newton, in a manner, is Jesus' chiasmus: not a perfect creation but a creation

engaged in conscious perfecting. At the mint, Newton's program of purification involves three subprogrammes: policing the mint and its "bodies," policing the organizational structure, and, the most literal policing of them all, uncovering and prosecuting counterfeiters.

The mint itself was failing in a number of areas. First, it could not keep to with the demand for new coinage. Following a serious devaluation of silver, the Parliament had issued a recoinage edict in 1696. However, both machinery and the human operators at the mint were inefficient. Additionally, even Newton's nominal boss, the actual Master of the mint, Thomas Neale, was "too distracted to give the recoinage the attention it demanded" (Westfall 223). Newton's responded by conducting detailed time-and-motion studies of the whole minting process (White 261), and based upon his analysis, modified both machinery and personnel accordingly. Significantly, according to an obviously admiring Haynes, Newton "could judge of the workman's diligence" and was thereby able to judge the individual efficiencies of the employees, treating them little differently than he did the machines themselves. Newton's analysis and subsequent control of the employees' behaviors down to the time it took to raise and lower an arm is telling. Working bodies are being "purified" into ordered parts of a larger whole, with the end—successful operation of the mint—the only important measure of the bodies' worth.

However, Newton doesn't stop with the actual internal functioning of the mint. Newton, at first thinking that the position of warden made him the real master of the mint, was soon surprised to find that although he managed all of the mint's duties, Neale was officially in charge and, though consistently neglectful of the mint's operations, controlled the budget, and thereby controlled Newton at a foundational level. To return

the mint to its proper order, Newton petitioned the Treasury directly a number of times, requesting both a raise and control of the purse. In private, he referred to Neale as "a Gentleman who was in debt and of a prodigal temper and by irregular practices insinuated himself into Ye office" (qtd in Westfall 225). Failing at a number of attempts to get the Treasury officials to comply, Newton conducted a typically "Newtonian" massive examination of all documents, edicts, proclamations, and records pertaining to the mint and its history, and developed an elaborate argument for a return to the mint's true state, where Newton as warden maintains complete control. White writes of Newton's study of the mint's history and structure:

> Here is the dark shadow of the obsessive Arian at work, preparing to dispute the validity of the Trinity, scouring the Book of Revelation and unraveling the prophecies from the Book of Daniel. Once again he was in search of validation of his claims, this was no divine battle but a fight for privilege, God was not to be founding the Mint documents, but the elevations of Newton's own ego most certainly was. (264)

White is correct in noting the symmetry here between the Arian and the mint historian, but this effort is no shadow. Rather, Newton is always and everywhere the Arian, and in this instance he is in full blaze, purifying the corrupted story of the mint. As the true "master," as proven by the success of his purified mint-as-machine, Newton's place in the hierarchy is that of a high-ranking official in "Noah's government." In Newton's system, even "ego" is not a problem; after all, an overseer answering only to the Lord of the manor has not only a right but also a necessity to be "above" the lesser, as Jesus is "over" the human yet "under" God the Father. That the machine metaphor brings with it

an interchangeability of parts, which suggests anyone could in potential re-place Newton in the hierarchy, also poses no problem, as Newton has proven his fitness. The increased output of genuine gold coins is analogous to the transmutation of lead into gold for the alchemist, a material sign of a spiritual purification.

One could argue that Newton's treatment of the mint's human and nonhuman "machines," and his attempt to re-machine the political structure of the mint are only remotely Arian Puritanical, and are only logical—even secular—attempts to use whatever means necessary to promote one's status. However, Newton's treatment of counterfeiter's, though certainly methodical, goes beyond hyper-efficiency and obsessive engagement. Along with the recoinage issue and the shaky state of Britain's finances, the mint is also burdened with an astonishing outbreak of counterfeiting. In response, Newton extends the reach of the mint's authority in identifying and pressing charges against counterfeiters. Not content with merely streamlining the process of investigation and interrogation, Newton personally became involved, creating a large network of underground contacts, going undercover in London's shabbiest districts, and even conducting interrogations himself in the Tower of potential witnesses reluctant to come forth voluntarily. White documents the extent of Newton's involvement:

> Between June 1698 and Christmas 1699 he conducted some 200 cross-examinations of witnesses, informers and suspects, and in a single week in February 1699 he attended seven such sessions and had ten prisoners in Newgate Prison awaiting hanging. He treated petty criminal and the grand larcenist with equal contempt, once commenting, "Criminals, like dogs, always return to their vomit." (266)

All of Newton's significant biographers have grappled with Newton's behavior at this time, agreeing in general as to the near Gestapo tactics—and his "stretching of the law" (Christenson 109) in his questionable means of prosecuting the case against the famous forger, William Chaloner. In that instance, Newton employed several convicts to testify against Chaloner, who, though having an extensive history of criminality, is likely to have been innocent of the crimes for which he was hanged (Christensen 109). Where biographers differ is in how they explain Newton's behavior towards those suspected of any level of involvement with counterfeiting. Some argue for psychopathology, such as Frank Manuel in The Religion of Isaac Newton, who maintains Newton's ferocity in pursuing criminals, and his frequent refusal to grant pardons in even the most questionable cases, reflected a form of displacement, where Newton acted out his hatred for his step-father on people, the lower class, whom he felt were contemptible from the outset. Others, such as Westfall, down play the behavior, attributing it to the brutal times and the emergency brought about by the coinage crisis. White is less forgiving: "This was the chance for him to wield real power—power over life itself. With a wave of his hand, he could have sent a man to the gallows, but he could also show mercy and offer life to those groveling at his feet" (268).

White, in my analysis, is the most accurate—as far as he goes. Certainly Newton is experiencing for the first time the power of life and death judgment. Yet given his form of Arian theology, in which violent death is an essential method of purification for God's first perfect creation, Jesus himself, and that all purifications are, at some level, re-expressions or re-presentations of a divinely designed order, then Newton's acts with the counterfeiters are not mere psychological aberration, signs of the times, or even a man

given a taste of power. Instead, his actions are embodied purifications of the world politique, editions and corrections of the book of the human. Given that counterfeiting is in many ways a perversion of alchemy, a transmuting of a base element into the semblance of gold, the counterfeiter's actions threaten not merely the money supply but the idea of purity itself. What we get with Newton's brutish tactics here is our only example of his full application of his system of systems into the realm of the tiny fragile human, where what is at stake is more than accurate prediction of orbits, more than the purifying of base elements into pure forms, more than the accurate translation of sacred texts, and even more than the translation of governmental systems. What Newton reveals as a very energetic, methodical, and Machiavellian prosecutor of counterfeiters is the true status of the body in his system: a slave to the order, expendable in the pursuit of perfection, and, ultimately, an impediment to perfection when not playing the "part" that the machine requires.

What I have traced in Newton's method and results of approaching sacred texts is an epistemology that combines the principles of Enlightenment science with the stance of the transmutative alchemist, all the while drawing its primary authority from a very complex sense of God. That "scientific" and "magical" sense of God involves not a mere removal of the purpose from things but rather the replacement of individual purpose with a larger, lawful purposefulness. Newton's approach to sacred texts is informed by a basic assumption that the process of history is one of increasing corruption, and it is the task of the translator—the one truly "literate" in reading the bible—to re-cover the once perfect understanding of god through application of the Newtonian scientific method. For Newton, that recovered understanding is increasing recognition of the radical rank-

orderedness of all facets of the world. In this vein, Newton's work at the mint reflects not a sidelight to his studies but rather their culmination in the world of the social, where the "force" studied and manipulated is the force of money, the power of acquired resources that underlies the strength of all governments. In the end, Newton's Mint work is an experiment in application with decidedly mixed results. On the one hand, his system of systems arguably saves the empire, and perhaps more importantly over time, provides a model of "scientific management" that can maximize the machine-like efficiency of human institutions. However, what is lost in this system is a sense of a human value not dependent upon a radically subservient role in relation to a distant God. As I explore in the next chapter, Newton's intermingling of both grounding assumptions and methods from Natural Philosophy and Arian theology did prove especially productive in the development of modern science. In the end Newton's attempt, however brilliant, has serious limits, both in ultimately representing the physical world and in re-presenting a humane social order.

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CHAPTER FIVE

ISAAC NEWTON AND NIELS BOHR: KNIGHTS OF THE ABSURD

That Isaac Newton and Niels Bohr are scientists is to state the obvious; volumes abound on their respective contributions in physics and mathematics. This is the old tired story of giants of science, redolent of strict objectivity, experimental rigor, and arcane but brilliant formulae, somehow capturing, in a modern kind of Sanskrit, knowledge of the physical universe. This story, as far as it goes, is "true," at least in the sense that they have contributed to science, and are very much active voices in many fields of inquiry. As I have shown in the prior chapters, Newton was much more than a stereotyped scientist: both theology and alchemy saturated his work. In this chapter, I position both Bohr and Newton as "alchemists," Newton in the formal sense and Bohr in the analogical. Further, both are quasi- Kierkegaardian "Knights of the Absurd," whose general philosophies have at their respective cores a direct rendezvous with paradox. A distinctive feature of each of their approaches, in Newton, in his quest for a "unity of truth," and in Bohr, his quest for a "Unity of Knowledge," is an unmistakable integration of fundamental contradiction within a larger framework of order. In Newton, the larger system of order is his Arian theology, which subsumes both his "scientific" studies in Natural Philosophy and his "magical" studies on alchemy. In Bohr, this larger system of order is his frame of "complementarity," a concept he applies to make sense of not only quantum physical experimental findings but also to integrate the larger systems of classical physics and quantum physics into a single epistemological framework. Both, indeed, are heretics: Newton as a radical Puritan Arian who adamantly denies the

existence of the trinity, and Bohr, as an "antiepistemologist," according to Arkady Plotinisky, who critically positions Bohr's approach as a complex application of George Bataille's general economy model, and Derrida's post-structural philosophy.

For both, as well, their respective embracings of absurdity entail not only the nature of subject-object splits but also, in a Kierkegaardian sense, the nature of subjective and objective knowledge and ways of knowing. Newton, the ostensible spokesperson for objectivity, particularly in the sense of a radical separation of observed from observer, when considered within the larger framework of his studies of alchemy and theology, is revealed as less a scientist within a veneer of magic and religion than as a priest who dabbles both in science and magic. His goal, treated here as a quest for a unity of truth undertaken by a Knight of the absurd, is one effected through a series of translations: of the corrupt world into a perfect set of laws, of the corrupt self into a more perfect reflection of the creator, and of corrupt text into a perfect prediction after the fact of God's omniscience. His treatment of subject-object distinctions is to work within an ensemble of epistemologies: Natural Philosophy, where the object is foregrounded, and the subject stands "silent," a disinterested witness; and alchemy, where the exact obverse is at play: the subject, the alchemist himself, is foregrounded, and the object, the materials with which the alchemist works, are witnesses to the transmutation of the subject. The two seemingly exclusive, if not contradictory, approaches to "truth" are reconciled in an existential leap of faith—in the assertion of belief in a radically, and significantly, "unitary" God. The darkest of ironies pervades this uneasy ensemblage: Newton, whose historical moment is populated by radical social upheaval, an upheaval complicit in and contiguous with religious, scientific, and personal "revolutions," is bent

upon both addressing the increasing disorder and thrusting meaning on it.

Bohr, similarly working in a time of political, scientific, and religious disorder, has as his goal a quest for a unity of knowledge, which also involves a confrontation with subject-object distinctions. He, too, works within an ensemblage of epistemologies—classical physics, primarily informed by the Natural Philosophy outlined in Newton's Principia, with its central assumption of radical subject-object split; and quantum physics, where, in an ironic twist, application of Newtonian objectivity in experimental design results in a demonstration of the limits of objectivity as the central method for representing truth. Bohr resolves the contradiction between the two systems of representation by positing the framework of complementarily, where the central irony is that the contradiction becomes not a marginal occurrence to be glossed over to maintain a unity of knowing, but rather the driving principle behind unifying knowledge so that "knowledge" itself is redefined as that which can be communicated. Since contradiction is at the heart of the relationship between quantum physics and classical physics, unification, for Bohr, involves an embracing of that contradiction as a fundamental law of the universe. In the end, an important difference between the two thinkers is that Newton's leap of faith presupposes a once and future truth—an originary and eventual demonstration of the veracity of the faith, which falls short of a true Kierkegaardian mastery of irony. Bohr, in contrast, though perhaps initially hopeful for such determination of truth, is content with increasing refinement of —but never completion of—a process of understanding and communicating that which can be known.

Until recently, historians and philosophers of science viewed Newton primarily as the "father of classical Physics" who worked on gravity, mathematics, optics, and the

codification of a general scientific empirical methodology. He stands as a kind of model of the mostly solitary genius, working in a disinterested, secular fashion after verifiable understanding of the material world. Newton's work in Natural Philosophy, best represented by his Principia and his later Opticks, received widespread recognition, both during and after his life. William Blake , in his painting, "Newton" and his poem, "Urizen," directs his Romantic critique to this representation of Newton: the Newton of material science, mathematical abstraction, and reduction to surfaces.

6. And Urizen craving with hunger
Stung with the odours of Nature
Explor'd his dens around

7. He form'd a line & a plummet
To divide the Abyss beneath.
He form'd a dividing rule:

8. He formed scales to weigh;
He formed massy weights;
He formed a brazen quadrant;
He formed golden compasses
And began to explore the Abyss
And he planted a garden of fruits

This is the Newton of the falling apple, of the calculus—the objectifying and objectified Newton, whose works will serve as both bibles of objects and bibles of objectivity. To a certain extent, this is, if not the definitive Newton, then at least a defensible Newton. By the age of 26, Newton had not only developed the calculus, his fluxions, he had also

provided the most comprehensive and rigorous account of the behavior of light and the phenomenon of gravity of any scholar in the history of the Western world. Certainly, it has been known from the outset that Newton also worked in theology and alchemy, but these two additional areas of Newton's overall inquiry have been treated as vestiges of a more ignorant era—Newton's blind alleys, so to speak—areas in which he wasted time which could have been better spent contributing to human understanding of the physical universe. Even immediately following Newton's death, when the Royal Society received Newton's unpublished papers, all texts dealing with alchemy and theology were deemed unfit to publish and were returned to his family, where they languished until this century (White 10).

However, as I have traced in the prior chapters, a number of recent scholars have looked more closely at Newton's work in theology and alchemy. For example, Robert Markley, in his Fallen Languages, argues that early versions of both Boyle and Newton's scientific work exhibited marked dialogic polyphony in which a tension emerges between theology and scientific inquiry (143-146). This dialogic tension, according to Markley, was squelched by later redactors, who erased the religious overtones while retaining the truth-value power of theocentricism, transferring it to the experimental method itself (247). What emerges from such redactions is an edited view of Newton and Boyle which better fits the until recently uncontested idea that Newton et al. were purely objective scientists closer in epistemology to the average university chemistry professor than to seventeenth century eclectic thinkers. Similarly, Betty Jo Teeter Dobbs argues in her seminal The Janus Face of Genius that Newton was not only more interested in alchemy than Natural Philosophy: his major contributions to physics, notably his concept of

"action-at-a-distance" to describe gravity, were the fruits of his lifelong studies in alchemy.

For Dobbs, Newton's work in multiple systems of representation allowed for a "self-correcting feature" to emerge—a figure of the cross-pollinations and interconceptualizations of his respective fields of study—but a self-correction that was more than a rigorous skepticism: it implied a deep conviction in an overall truth:

> Newton was not a skeptic. On the contrary he seems to have adopted a contemporary response to questions of valid knowledge called the doctrine of the "unity of truth," a position that was in fact one answer to the problem of skepticism. Not only did Newton respect the idea that truth was accessible to the human mind, but also he was very much inclined to accord to several systems of thought the right to claim access to some aspect of truth. For those who adopted this point of view, the many different systems they encountered tended to appear complementary rather than competitive. The assumption they made was that Truth did exist somewhere beyond the apparently conflicting representations of it currently available. True knowledge was unitary, and its unity was guaranteed by the unity of the Deity, He being the source of all Truth. (Newton and Culture 9)

If Newton, as Dobbs maintains, was not a skeptic, then what was he? A believer is the obvious implication, but of what—science, theology, alchemy? Even a cursory examination of Newton's science, as represented by the Principia and the Opticks, as well as factors surrounding their production, and his Arian theology, and his alchemy, suggest

that any reasonable balancing between these systems of representation is problematic—requiring not one but numerous "accountings of" contradiction and absurdity. What really complicates the sense of paradox embraced is Newton's obsessive systematization in all three fields of inquiry. The role of the observer, the subject, in particular, when positioned in Newton's Natural Philosophy and alchemy, suggests an absurd contradiction.

In Newton's Natural Philosophy, the subject is necessarily utterly removed from the object. In a manner of speaking, Newtonian Natural Philosophy, as outlined in the Principia in "Rules of Reasoning" is an "experimental philosophy" in which "nature speaks for herself, . . . always simple and always and ever consonant with itself" (795). The role of a subjective observer in such a system is one of the detached witness—not only assumed to have detachment from that which is being observed, but also constrained in participating in making sense of what is observed. Newton notes, "Certainly idle fancies ought not to be fabricated recklessly against the evidence of experiments" in his "Rules" (795), and even goes so far as to conclude the Principia with his famous *hypothesis non fingo*—I feign no hypothesis (943). Rule four in particular implicitly underscores the sharp separation of observed from observer, of object from subject;

> *In experimental philosophy, propositions gathered from phenomena by induction schooled? be considered either exactly or very nearly true notwithstanding any contrary hypothesis, until yet other phenomena make such propositions either more exact or liable to exceptions* [italics Newton's]. (796)

Note what performs the action of truth verification: the phenomena themselves—not the

observer, who not only merely watches but who also is constrained from "contaminating" the observations' immanent truth with transcendent theorizing. At its extreme, such radical empiricizing almost completely isolates the subject from even interpreting the observations, that is, from finding a larger, unifying meaning across them. It is interesting to note as well how Newton uses modes to both underline and complicate his Natural Philosophy. When he discusses the various propositions throughout the Principia, his mode, as he outlines problem examples, is imperative—"Let line a equal" and so on. However, when he approaches hypothesizing beyond the experimental data itself, he uses the interrogative—foregrounding its "question-ability" by calling his thrusting of meaning onto the observations "queries." For example, note the following query from Opticks:

> *Have not the small particles of bodies certain powers, virtues or forces, by which they act at a distance, not only upon the rays of light for reflecting, refracting, and inflecting them, but also upon one another for producing a great part of the phenomena of nature? For it's well known, that bodies act upon one another by the attractions of gravity, magnetism, and electricity; and these instances shew the tenor and course of nature, and make it not improbable but that there may be more attractive powers than these. For nature is very consonant and conformable to herself* [italics Newton's]. (375-376)

This passage is interesting on a number of levels, including its presentations as one of the "Queries." In this particular quote, the concept of action-at-a-distance is presented as "well known," so self evidently true that it serves as the basis to infer similar "more

attractive Powers." It is also easy to interpret this passage as a prefiguring of what Einstein would discover several centuries later, namely that gravity does act on light. What interests me here, however, is not the prophetic quality of Newton's questions but rather the context in which the principle of action-at-a-distance would arise and the concept of "nature conformable to herself" would function as a principle of cohesion.

In contrast to our easy acceptance of action-at-a-distance in contemporary understanding of gravity, in Newton's time it was a highly controversial principle. Even Swift satirizes it as a passing fad in Gulliver's Travels:

> he predicted the same fate to *attraction*, whereof the present learned are such zealous asserters. He said, that new systems of nature were but new fashions which would vary in every age: and even those who pretend to demonstrate them from mathematical principles, would flourish but a shirt period of time, and be out of vogue when that was determined. (235)

Predominating in the so-called scientific circles of the late 1600's, especially in the Royal Society, was Cartesian mechanics, which necessitated the postulation of an "ether" –a "spirit of air" (Shapin 23) to use Newton's words, which would provide the medium through which mechanical action could transpire. For example, prior to Newton, explanations of one body acting on another involved the action of the first body carried through the ether to affect the second body. Descartes' mechanical philosophy had gravity as arising from the behavior of clusters of matter and spinning vortices that acted like whirlpools in the ether. The ether itself was described as weightless and invisible, filling up all space and facilitating all action (White 205-207).

In such a scheme of things, in such a system of representation that had come to

pervade much of seventeenth century Natural Philosophy, things themselves were inert, passive. The surface of things was not only important: it was enough—no need to attribute a spirit or a force to things. Yet Newton posits the "occult" force of action-at-a-distance—ironically to account for observations, confirmed by mathematics, that the effect of ether, if any, on bodies was so negligible as to be unimportant. For the mechanics to work, a nonmechanical principle must be included. Significantly, in the above quote the move is from "surfaces," the stuff of Cartesian mechanics, to solids. At the minimum this move clouds the picture of Newton as a purely "ocular" empiricist.

Both Newton's "discovery" of action-at-a-distance and his "bravery" at publicly presenting it seem less remarkable, if not almost unavoidable, if one considers another system of representation exclusive of Natural Philosophy: Newton's nearly lifelong studies in alchemy, begun in earnest—ironically, considering the secular direction Newtonism, has taken, when he was named a fellow at Trinity College in Cambridge in 1665. In Chapter Three, I examined Newton's alchemy in light of its relation to his psychology. Here, my interest is on how central principles of Newton's alchemy worked in his system of Natural Philosophy. Attributing an active principle to an object is at the crux of alchemy, where efforts to transmute both substance and self from imperfect to more perfect states involves direct address to the active principle, the spirits of things. And in alchemy the surface of the materials is not the focus: instead, it is the "depths" of the substance, imbued with life.

Newton's alchemical move from surface to depth, from inert stuff to active principles, is apparent in the following from the General Scholium at the end of the Principia

> Thus far I have explained the phenomena of the heavens and of our sea by force of gravity, but I have not yet assigned a cause to gravity. Indeed, this force arises from some cause that penetrates as far as the centers of the sun and planets without any diminution in its power to act, and that acts not in proportion to the quantity of *surfaces* of the particles on which it acts (as mechanical causes are wont to do) but in proportion to the quantity of *solid* matter, and whose action is extended everywhere to immense distance, always decreasing as squares of the distances. (943)

Newton follows this description with his now famous *hypothesis non fingo*, saying, "for whatever is not deduced from the phenomena must be called an hypothesis; and hypotheses, whether metaphysical or physical, or based on occult properties, or mechanical, have no place in experimental philosophy" (943). Newton seems to be fudging here. His action-at-a-distance, used to explain phenomena, does not qualify as a hypothesis because he doesn't speculate as to its cause. Its presence is assumed to be self evidently true, as is the "very subtle spirit pervading gross bodies and lying hidden in them" (944). A seeming dialogic tension is evident, where two systems of representation—experimental philosophy and alchemy—are competing for vocality, for truth valuing. In fact, a third system can also be assumed to add to the cacophony—Newton's religion, his Arian theology. Consider this from the section immediately preceding the above in the General Scholium:

> It is agreed that the supreme God necessarily exists, and by the same necessity he is *always* and *everywhere.* It follows that all of him is like himself: he is all eye, all ear, all brain, all arm, all force of sensing, of

> understanding, and of acting, but in a way not at all human, in a way not at all corporeal, in a way utterly unknown to us. . . For all discourse about God is derived through a certain similitude from things human, while not perfect is nevertheless a similitude of some kind. (942)

This unknowable being, however, is somewhat knowable: Newton adds, "to treat of god from phenomena is certainly a part of 'natural' philosophy" (943). This particular statement is clue not only to Newton's Natural Philosophy, but, as I have been arguing throughout this dissertation, also to the entire complex of his approach to knowledge in the face of absurd contradiction. Newton in many respects faced exactly the opposite problem that Galileo faced, from whom he derives much of his reliance upon the experimental method. Specifically, as I noted in Chapter Four, Newton's Arian theology was a direct threat to the religious and political forces of his day, both in his semi-private sphere at Cambridge and in the larger sphere of seventeenth-century religion and politics. Arian theology maintains that there is one God that cannot be divided into father, son, and spirit. In short, Jesus is not God, according to the followers of the fourth century monk Arias; he is instead God's first perfect creation. In this way, Jesus functions as a kind of *ubermensch* between God, the world of perfection, unity, and truth; and nature, the world of imperfection, partialization, and corruption. Natural Philosophy, in this worldview, is at the very bottom of the perfection-imperfection continuum. Even alchemy, with its emphasis on transmutation not of the base elements but of the alchemist himself, is closer to perfect than is physics, which is doomed from the start to be less than God, though, as the quote above notes, physics still reflects God, as a kind of imperfect mirror (Janus 80-84).

Newton's necessarily covert work in theology was paralleled by a comparable covert activity in alchemy. Alchemy, like Arianism, is constrained from public presentation: Newton even went so far as to admonish Boyle for publicizing alchemical secrets—not because they were superstition but because alchemy itself was by definition a secretive practice with findings so powerful they were not to be trusted in the hands of an initiate, that is, someone without the necessary degree of self perfection to facilitate the alchemical process.

One way to contextualize his philosophy—natural, alchemical, and theological—is hierarchical, a kind of ladder moving from imperfection to perfect, as I argue in the Introduction. Natural Philosophy, studying the book of nature, is at the bottom rung. Alchemy, with its shift from the passive study of the object, and its concomitant reliance on sharp subject-object separation, to the active study of the subject, is the translation point from the corruption and disorder of nature to the perfection and unity (read ultimate order) of God. Newton's grand leap of faith involves an unwavering belief in the perfection and unity of God, and the paradox of using corrupt nature and corrupt humans to get to God can be reframed as a Kierkegaardian double move of simultaneously recognizing the number of central paradoxes while nevertheless asserting a larger subjective—and ultimately "unprovable" meaning across the whole shebang. The best fit between a true Kierkegaardian existentialism and these three systems of representation is in the alchemical process itself. Consider the following from Fear and Trembling:

> And yet, and yet the whole earthly form he exhibits is a new creation by virtue of the absurd. He resigned everything infinitely, and then he grasped everything by virtue of the absurd. He constantly makes the

> movements of infinity, but he does so with such correctness and he assurance that he constantly gets the finite out of it, and there is not a second when one has a notion of anything else. It is supposed to be a difficult task for the dancer to leap into a definite posture in such a way that there is not a second when he is grasping after the posture. Perhaps no dancer can do it—that is what the Knight does. (51)

In many ways, this sounds like the process of transmutation described by the alchemists—there is a sense of always reaching towards perfection, of becoming rather than being. And the critical element in this process is not the object—the stuff of the experiments, whether they be lead or acid or fire: it is the alchemist himself who both determines the success of the grasp towards perfection and who is the ultimate subject of the alchemical study itself. This focus on the subject seems dramatically incompatible with natural philosophies focus on the object, especially in light of generalizability of not just observations but the very method of observation itself. Yet for Newton, a Knight of the absurd, his inherent acceptance of absurd contradiction was glossed over by later writers who attempted to describe his Natural Philosophy within its own parameters. By the time that Bohr begins his work in physics, what remains of Newton is his Natural Philosophy, particularly his rigorous experimental method with its sharp separation of subject and object. The irony here is that it is neither God nor alchemical revelations that spark Bohr to embrace the absurd: instead, it is the experimental findings of physics themselves.

Bohr, Complementarity, and Unity of Knowledge

What Bohr was initially after was an understanding of the tiniest bits of the

universe, to study them and their behavior in order to determine if some underlying lawfulness is evident. He begins, as do Einstein, Heisenberg, Bell, and a host of others, by working within the framework of scientific objectivity. By objectivity I mean here the narrow sense of the stance a scientist takes towards an "object" of study in which the assumption is made that the empirical observer does not significantly affect the outcome of a properly designed experiment. In short, he works firmly within the four rules of consequence outlined by Newton in the Principia.

However, in light of the experimental findings of quantum physics, particularly those dealing with wave-particle, momentum-position observations, Bohr begins to question the very nature of an "independent reality in the ordinary physical sense" and his "answer" to the question is complementarity, which is not so much an "answer" in the classic sense as it is a new way of framing questions outside of a purely "Newtonian," deterministic, and linearly causal lens. At the risk of over simplification, what was discovered in a series of experiments beginning in the first quarter of the twentieth century was that it was impossible to account for experimental findings—and by extension, the laws of the physical universe—without including the role of the observer in the description. In contextualizing the duality of the wave-particle observations in physics, Bohr reframes the seeming paradox: "In fact, here again we are not dealing with contradictory but with *complementary* pictures of the phenomena, which only together offer a natural generalization of the classical mode of description" (Atomic Theory and the Description of Nature 68). For Bohr, this means not that perceptions of particles cause a phenomena nor that the particles cause a perception, but rather that observer and observed are inseparable, just as wave and particle studies reveal the "complementary"

nature of light. On the face of it, viewed within the framework of "Newtonian" science (his Natural Philosophy isolated from his theology and alchemy), the experimental findings are absurd: following Newton, one expects to find causal explanations that exclude the role of the observer in the study. Unfortunately, old "intuitive" notions of causality don't work in Bohr's quantum world:

> In this novel situation, where experimental conditions "determine" the behavior of particles, even the old question of an ultimate determinacy of natural phenomena has lost its conceptual basis, and it is against this background that the viewpoint of complementarity presents itself as a rational generalization of the very ideal of causality. (Atomic Theory and the Description of Nature 54)

Bohr elaborates on the quantum physical situation:

> Within the scope of classical physics, all characteristic properties can in principle be ascertained by a single experimental arrangement, although in practice various arrangements are often convenient for the study of different aspects of the situation. In fact, data obtained in such a way simply supplement each other and can be combined into a consistent picture of the behavior of the object under investigation. In quantum physics, however, evidence about atomic objects obtained by different experimental arrangements exhibits a novel kind of complementary relationship. Indeed, it must be recognized that such evidence which appears contradictory when combination into a single picture is attempted, exhausts all conceivable knowledge about the object. Far from restricting

> our efforts to put questions to nature in the form of experiments, the notion of complementarity simply characterizes the answers we can receive by such inquiry, whenever the interaction between the measuring instruments and the objects form an integral part of the phenomena. (Essays 1958-1962 on Atomic Physics and Human Knowledge 4)

Complementarity, as Bohr says, initially suggested itself as a conceptual framework "wide enough to embrace the account of the fundamental regularities of nature which cannot be comprehended within a single picture" (Atomic Physics and Human Knowledge 12). In this instance, he is referring specifically to the findings of quantum physical experiments, and the inability for classical models to account for those findings. In other words, complementarity "simply characterizes the answers we can receive by such inquiry" (4). In this situation, the process involves conducting an experiment, translating the results into mathematics—here, Hamiltonian matrix algebra, and then translating what the math reveals into "unambiguous language" (3). However, this process of translation involves contradiction and paradox at every step. First, the experimental findings themselves are absurd—Schrodinger called the photographic evidence "repugnant;" Bohr's initial response was that it was "hopeless." Secondly, the very math used to represent the findings—unlike Newton's unabsurd calculus—contains within in fundamental absurd contradictions. Consider the following formulae for uncertainty relations:

$$pq - qp = \sqrt{-1}\,\frac{h}{2\pi}. \qquad \ldots\ldots(3)$$

(Bohr Essays: 1932-1957: Atomic Theory and Human Knowledge 71)

On at least two levels, fundamental contradiction is evident in this equation. First,

the statement p—q reflects the noncommutative function necessary for Hamiltonian matrix algebra to work. This is a direct contradiction of a fundamental principle of algebra. Secondly, and perhaps even more importantly, the deployment of the square root of negative one also reflects an impossibility: called an "imaginary number," this particular symbol is at the heart of mathematical representation of quantum physical behavior. Much, of course, has been written about the meaning of this number: I am merely pointing out that even in the supposedly rational world of mathematics, in its application in arguably the "hardest" of the sciences, a certain irrationality is evident, a willful embracing of fundamental absurdity in order to represent the "order" of the world.

Having made the leap to recognize the paradoxical experimental findings, and accepting the absurd math behind them, Bohr extended complementarity to description of other phenomena beyond the quantum physical, in particular psychology. Though at first Bohr was to reflect "a feature of wholeness inherent in atomic process" (2), his development of complementarity matured into a larger framework to account for features of wholeness and subject-object complements in many phenomena, not just physical, biological, and psychological but also legal, ethical, and even cultural. Bohr begins by trying to account for the observations of physical quanta under different experimental conditions. When it becomes clear that a "single picture" cannot provide a complete description of physical processes, he broadens not just his descriptions but also his general epistemology to provide

> a radical revision of the foundation for the unambiguous use of most of our elementary concepts....Indeed, from our present standpoint, physics is to be regarded not so much as the study of something a priori given, but

> rather as the developments for ordering and surveying human experience, in this respect our task must be to account for such experience in a manner independent of individual subjective judgment and therefore objective in the sense that it can be unambiguously communicated in the common human language." (Essays: 1932-1957: Atomic Physics and Human Knowledge 10)

Most interesting, however, is how his principle of complementarity can be used to not only account for different experimental results discovered under different experimental arrangements but how complementarity can provide a basis for finding a "unity of knowledge," for addressing what Bohr saw as "the widespread confusion arising from the apparently divergent approaches taken by humanists and scientists to human problems" which has resulted in "talk about a cultural rift in modern society" (Essays: 1932-1957: Atomic Theory and Human Knowledge 8), reminiscent of C.P. Snow's "two cultures." Important here is to note that Bohr is not asking for a return to a subjectivism or pure perspectivism. Rather, he is straddling the margin between subjectivism and objectivism, retaining the primacy of the observer of the former while retaining empirical "power" of the latter. His general epistemology addresses his sense that "the integrity of living organisms and the characteristics of conscious individuals and humans cultures present features of wholeness, the account of which implies a typical complementary mode of description" (Essays:1932 -1957: Atomic Physics and Human Knowledge 7). In short, Bohr provides a radically different framework of knowing in which humans can find a "proper balance between our desire for an all-embracing way of looking at life in its multifarious aspects and our power of expressing ourselves in a logically consistent

manner" (Essays: 1932-1957: Atomic Physics and Human Knowledge 80). And behind his attempt to provide this new epistemology is also a pragmatic concern with living. As he says, "the problem of unity of knowledge can hardly be separated from the striving for universal understanding as a means of elevating human culture" (Essays: 1932-1957: Atomic Physics and Human Knowledge 81).

More than just another way to describe the counter-intuitive findings of quantum physics, Bohr's complementarity is a hybrid of Newtonian systems of representation in which an uneasy marriage is effected between the objective method of Natural Philosophy and the subjective method of alchemy in order to return to the enterprise of human inquiry in all areas a way to provide a more or less complete description of life, whether psychic, social, or political. Bohr's frame of complementarity is less a "theory" than it is a "faith-based" accounting for multiple systems of representation needed to get an "exhaustive" description of nature and examining the interrelationships between those systems of representation. As Bohr notes in reference to the complementary description of wave particle light behavior, each system of observation—the experimental arrangements—is a limited or closed system. Absurdly, each system both excludes the other while simultaneously is dependent upon the other. In short, these systems of representation both help "determine" what is selected in the observation and what is selected out.

The starting point for Bohr's development of the frame of complementarity was recognition of the limits of "Newtonian" physics, with its sharp separability of subject-object and its concomitant assertion of linear causality. Simply, he began attempting to describe both the wave-particalization evidenced on the photographic plates and its

mathematical counterpart, Heisenberg's uncertainty relations. Newton's leap of faith—his resolution of contradictions and paradoxes both between and within his systems of representation—is a default to a belief in the unity of truth, and that truth was always and already reflective of the Arian unified god. Bohr's leap of faith, however, is even more complicated: he not only recognizes absurd contradiction as a central facet of human experience, he raises such absurdity to the level of a law, and by doing so, is able to offer a more-or-less complete epistemology which allows for conflicting systems of representation—such as classical vs. quantum physics—while also suggesting that such conflict is necessary to understand the order of the universe. In the end, his greatest faith is in the possibility of a unity of knowledge, which is intimately tied to the idea of that which not only can be observed but that which can be communicated in "common language." Note in the quote below how he brings together the incompatible systems of classical and quantum physics via language:

> In this context, one sometimes speaks of "disturbance of phenomena by observation" or "creation of physical attributes to atomic objects by measurements." Such phrases, however, are apt to cause confusion, since words like phenomena and observation, just as attributes and measurements, are here used in a way incompatible with common language and practical definition. On the lines of objective description, it is indeed more appropriate to use the word phenomenon to refer to only observations obtained under circumstances whose description includes an account of the whole experimental arrangement. In such terminology, the observational problem in quantum physics is deprived of any special

> intricacy and we are, moreover, directly reminded that every atomic phenomenon is closed in the sense that its observation is based on registrations obtained by means of suitable amplification devices with irreversible functionings…. In this connection, it is important to realize that the quantum mechanical-formalism permits well-defined applications referring only to such closed phenomena. Also in this respect it represents a rational generalization of classical physics in which every stage of the course of the events is described by measurable quantities. (Essays: 1932-1957: Atomic Physics and Human Knowledge 73)

The very simplicity of Bohr's prose hides the conceptual leaps he is requiring of the reader. Phenomena, for example, is limited to just those observations obtained under experimental conditions. However, observation in this instance—despite Bohr's attempt to return it to its classical physical objectivity—necessarily includes the observer, in short, the experimenter herself. Even if findings can be reduced to closed systems emergent of the world and the instruments of measurement, the act of choosing one particular experimental arrangement over another involves directly the observer's choice—and that choice helps determine what is discovered, and what is discovered—by Bohr's own account—involves a subjective choice as to objective design. If anything, complementarity may be better considered an "irrational" generalization of classical physics. Indeed, complementarity, with its emphasis on the role of the observer, could easily be positioned as a twentieth century alchemy in which, in an ironic twist, Newton's subjective methodology of alchemy, with its emphasis on interactions between subject and object, and on active principles of matter, is combined with his experimental method,

so that Bohr both subjectifies objectivity and objectifies subjectivity.

In doing so, Bohr makes a radical leap of faith in which he not only recognizes paradoxes and contradiction; he makes paradox and contradiction the central tenet of his complementarity. In this, he is a scientist-knight of the absurd: just as Newton introduced the concept of action-at-a-distance, borrowed from alchemy, to the theory of gravity, so, too, does Bohr bring into play an occult action-at-a-distance, a sort of observer gravity, in which the act of observation has nonmechanical consequences for what is being observed. In many ways, Bohr is a better fit with Kierkegaard's concept of the Knight who blissfully embraces contradiction—not as a threat to but as a source of his faith. Newton, in contrast, less makes his faith than assumes he is given it, via the Bible, *a priori*, and remains, to borrow from Kierkegaard, one who carries the "jewel of faith" and is partially "delusive, because [his] outward appearance bears a striking resemblance to that which the infinite resignation and faith profoundly despise…. To Philistinism" (49).

In the end, though Newton the crusty old Puritan seems to be the master of unintended irony, it is Bohr who more successfully embraces the absurd, who makes a movement of faith not against, but in light of, the absurd. His faith is saturated with irony: he believes in the unity of knowledge even as he recognizes the absurdity of finding a language commensurate with reality. He believes in the objective method even as he undermines it by foregrounding subjectivity. And he believes in "exhaustive" descriptions of nature even as he recognizes the confusion inherent in all descriptions. Perhaps even more remarkably, Bohr's complementarity, in his development of it, begins as a frame for "oppositional" activity at the quantum level, then is extended to provide a frame for "oppositional" physics of the Classical and the Quantum, and then is extended

to provide a frame for entire—and even opposed—epistemologies. For Newton, despite the power of his system(s), moves in the opposite direction—an ever narrowing gyre towards an assumed and closed truth. Newton, perhaps a squire of the absurd, is among the shrinking giants upon whose shoulders Bohr stands as a Knight, as a twentieth century alchemist, and as an "antiepistemologist" who believes devoutly in the effort after knowledge.

In the next chapter, I return to Bohr and Newton's respective epistemologies, using Bohr's concept of complementarity and goal of a "Unity of Knowledge" as a way to subsume both Newtonian and postNewtonian sciences under a larger epistemology, where seeming paradoxes and contradictions function instead as productive "complementarities."

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CHAPTER SIX

CONSTELLATION, UNCERTAINTY, AND INCOMPLETENESS: PROJECTING A HISTORY OF THE FUTURE

My focus in this chapter is on examining potential limits in that powerful system for representing things-in-themselves known as modern or Newtonian science. By modern science I mean that system of knowledge determination characterized by three primary principles: simplicity, generalizability, and verifiability, as outlined in Newton's Principia as the "Rules of Reasoning." Specifically, there corresponds to each of the "modern" characteristics of Newton's science a "postmodern response," one that in each instance reflects a limit in that characteristic's ability to accurately "re-present" the reality of the physical world. At the crux of each of the post-modern responses is the issue of variable human in the equation of truth. Niels Bohr's "complementarity," when applied as a way to resolve seeming oppositions between these "modern" and "postmodern" concepts, offers up a redefinition of the basic structure of scientific epistemology, one that shifts the underlying mode of truth-validation from "either-or" to "not only-but also," simultaneously retaining the power of "scientific" representations while also exposing certain limits in those systems of representation. Additionally, a Bohrian reframing of this set of seeming oppositions offers up interesting possibilities for both a human and humane science. By "human," I mean one that *accounts for* the participation of the human, that collection of tiny fragile bodies, in any representation of reality, from the human's "co-creation" of the particle in the collapse of the wave packet, to human's creative acts that make sense of observations with the stories of theory. By humane, I mean a science that is *accountable to* us human folk, one that will use all means in order

to invite a just "mode of subjectification." The exploration of limits is crucial to this enterprise. As Foucault says in "What is Enlightenment?", the primary task is to "characterize the philosophical ethos appropriate to the critical ontology of ourselves as an historico-practical test of the limits we may go beyond, and thus as work carried out by ourselves upon ourselves as free beings" (316).

That such an effort to get at an acceptable mode of subjectification will involve addressing "objectification," or more critically, Latour's "quasi-objectification," is a given: Newton's system(s) of representation in its various manifested appropriations has been revolutionary in consequence, both in technological developments interpenetrating cultural, social and psychological spheres, and in the technologizing of the human (Latour). Shapin's four aspects characterizing the general change in knowledge following the "scientific revolution" highlight the true extent of objective science's permeation into the human world: the mechanization of nature, the depersonalization of natural knowledge, the attempted mechanization of knowledge, and the use of "reformed natural knowledge to achieve moral, social, and political ends" (13). Donna Haraway's trope of the cyborg may, in fact, be more than metaphoric. From genetic advances that have left humanfolk at the threshold of recoding the body, to physical advances that allow for a sundering of the atom, "science," that is, Newton's intertwining of mathematical, theoretical, and observational systems of representation, is arguably the grandest of the conceptual actions-at-a-distance. That Newtonian science's epistemological power over the physical would be extended to other realms, areas such as the psychological, the social, and the cultural, seems inevitable, in retrospect, especially in light of Foucault's

understanding of the history of this "modern" epistemology, more as an "attitude" than as a "period."

Similarly, Foucault repositions the postmodern period as a set of "countermodern attitudes." According to Kern in The Culture of Time and Space, the late nineteenth and early twentieth centuries' unprecedented eruption of technological innovations suggested a "cultural revolution of the broadest scope was taking place, one that involved essential structures of human experience and basic forms of human expression" (6-7). As part of that "revolution," Walter Benjamin, Werner Heisenberg, and Kurt Gödel expose in their respective fields of study limits inherent in objective science. By exposing limits, I mean each theorist responds to a critical inadequacy of science's characteristics to re-present the world, especially a world that necessarily includes the human. Further, each of these characteristics also roughly matches one of the three systems Newton brought together—simplicity empowers theory, generalizability empowers observation, and verification empowers mathematics. These three " postmodernists" question, at different levels, the representational powers of their respective characteristics. Walter Benjamin, working in literary, political, and theological studies, offers a response to simplicity: constellation, a manner of representation that redefines conceptual rigor as that which liberates historical "facts" from their oppressive context. Similarly, Heisenberg, working in quantum physics, offers a response to the characteristic of generalizability: the uncertainty principle, a manner of representation that underscores both the probabilistic nature of the physical world and its ontological coupling with the human, the observer. Finally, Gödel, working in metamathematics, offers a response to verification: the incompleteness theorem, a kind of rule of representation that substantiates the fundamental inability of

any mathematical system to prove all statements. With each of these thinker's systems, the move is three-fold: an exposure of epistemological inadequacy, a re-introduction of the human into the system, and an expansion, rather than a displacement, of what could be called the epistemological frame.

Why Bohr?

It is that last move, what I am calling expansion of the epistemological frame, that seemed to demand an even larger frame—one that, perhaps ironically, "accounts for" the various responses' seeming oppositions to a fundamental characteristics of Enlightenment science. To provide that frame-of-frames, I employ Bohr's concept of complementarity.

Bohr, also an early twentieth century figure, could have functioned as a stand-in for Heisenberg, especially in his early work. However, Bohr's complementarity works also a larger level, one that accounts for its application at lower levels. To clarify: in Bohr's early work, especially those pieces written in the late 1920's and early 1930's, his complementarity is directed primarily at reframing the results of specific experiments, with their corresponding mathematical representations, involving the activity of quanta. He writes in his 1927 essay "Atomic Theory and Mechanics,"

> …it seems to follow that, in the general problem of quantum theory, one is forced with not a modification of the mechanical and electrodynamical theories describable in terms of the usual concepts, but with an essential failure of the pictures in space and time on which the description of natural phenomena has been hitherto been based. This failure appears also in a closer consideration of impact phenomena. In particular, for impacts

> in which the time of collision is short compared to the natural periods of the atom and for the very simple results are to be expected according to the usual mechanical ideas, the postulate of stationary states would seem irreconcilable with any description of the collision in space and time based on accepted ideas of atomic structure. (34-35)

Note Bohr's strong language—the "general problem," "essential failure," and "irreconcilable with any description." What Bohr is attempting to make sense of, specifically, are the wave-particle findings that led Heisenberg to develop his famous "uncertainty principle" to describe the experimenter's inability to measure both co-ordinate (position) and momentum of "wavicles." Bohr's complementarity, at this point in his application, is applied at the "lowest" level: accounting for "special" circumstances set up by the experimenter, requiring also "special" mathematics such as Hamiltonian matrix algebra. However, Bohr suggests the second level of application in the above quote—the potential general failure of classical mechanics to account for all observations.

Bohr's second level extension of complementarity from the special case of "complementary" quantum action of waves and particles to the "complementary" nature of classical and quantum mechanics characterizes his writing almost immediately after he uses the concept to argue for a revised accounting of quantum physical experiments. In his 1929 essay "The Atomic Theory and the Fundamental Principles Underlying the Description of Nature," he writes,

> The invocation of classical ideas, necessitated by the very nature of measurement, is, beforehand, tantamount to a renunciation of a strictly

> causal description. Such considerations lead immediately to the reciprocal uncertainty relations set up by Heisenberg and applied by him as the basis of a thorough investigation of the logical consistency of quantum mechanics. The fundamental indeterminacy which we meet here may… be considered as a direct expression of the absolute limitations of the applicability of visualizable phenomena, a limitation that appears in the apparent dilemma which presents itself in the question of the nature of light and matter. (114)

Bohr's "renunciation" of classical ideas is more than a simple rejection of Newtonian laws. Rather, he is arguing for an enlargement of the system in which classical physics and quantum physics are "complementary," both needed for an "exhaustive description" of nature, and both described relationally, with the same concepts used to make sense of wavicles—subject-object split, mutual exclusivity and interdependency—now extended to not only the "experimental behavior" of particles but also to the systems of understanding themselves. This move is radical:

> Niels Bohr's approach implied the abandonment of *determinism*; in absolute contrast to Newtonian physics, complete knowledge of the present may provide only statistical information about the future. Also abandoned would be *realism*, at least in the form of *naïve realism*, according to which any physical quality—position, speed, and so on—had a precise value at all times. (Whittaker "Preface" xiii)

Where complementarity at the lowest level functions exactly as Whitaker describes—a seeming abandonment of both determinism and naïve realism--

complementarity at the second level offers up an explanation of the relational nature of physic(s) themselves. At the second level, Newtonian—and Einsteinian—determinism and realism are part of the frame of description of phenomena, such as astrophysical, and are complemented by the nondeterministic and "informed" materialism of quantum physics.

What distinguishes Bohr's approach from other physicists such as Einstein's, Heisenberg's, Schrödinger's, Bell's and others, is that he doesn't stop with applications and articulations of first and second level complementarity. In his 1958, Bohr states in "The Unity of Knowledge:"

> The aim of all our argumentation is to emphasize that all experience, whether in science, philosophy or art, which may be helpful to mankind, must be capable of being communicated by human expression, and it is on this basis that we shall approach the question of the unity of knowledge. Confronted with the great diversity of cultural developments, we may therefore search for those features in " multifarious, often mutually exclusive, aspects. (14-15)

This quote addresses is what I have been treating as Bohr's third level application of complementarity, where the principle is extended to "account for" all areas of inquiry, that is, account for all systems of accounting. Of central importance to Bohr, the standards of "communicated by human expression" and "helpful to mankind" characterize his grand epistemology, with features, originally derived from quantum physics, such as mutual exclusivity and interdependency, employed on a continuum from

algorithmic application to heuristic exploration, critical concepts redefined and becoming more analogical as the level increases.

Also highlighted at the third level are the three criteria I mention earlier, characteristic of the three thinkers' respective responses: exposure of epistemological inadequacy, re-introduction of the human, and an expansion, rather than a displacement, of what could be called the epistemological frame. However, Bohr doesn't just account for these characteristics. Instead, he makes them central to his scheme of unity. A critical concept at issue for Bohr is an "element of wholeness… foreign to classical physics" (60). Life itself, he maintains, that is, "the place of living organisms within general physical experience," also can be framed as a set of complementarities ("Light and Life Revisited" 23). That element of wholeness, significantly, *may* be a description of a nexus between things-in-themselves, consciousness, sensation, and even "peoples," not only subsuming without violation the laws at every level, but ultimately defined by a nearly Gorgian sense of logos: "truth" is ever bound by what could be called Bohr's Law of "common language," that is, a language understandable to the extent that we are able to share the experience. As Bohr notes in "Quantum Physics and Philosophy, "The integrity of living organisms and the characteristics of conscious individual and human cultures present features of wholeness, the account of which implies a typically complementary mode of description" (7).

I say Bohr's complementarity *may* be a description of a kind of epistemological nexus. Bohr's own writing, though clear at the sentence level, reflects more an effort after a language to account for a unity of knowledge than a clearly articulated model of such a "nexus." Plotnitsky's *tour de force* analysis of Bohr's approach as a complex intertwining

of Bataille's General Economic model with Derrida's poststructural destabilization of language, though provocative in itself, also suggests an inherent problem with what Plotnitsky calls Bohr's "anti-epistemology" (Plotnitsky Complementarity). Though Bohr is committed to employing multiple "epistemologies" to capture not just an element of wholeness but what he perceives as an *elemental* wholeness characterizing all complex systems, he falls short of the mark. A "common language," one would assume, would not require the strenuous application of two particularly abstruse theories in order to decode it.

Perhaps I intend to complement Plotnitsky's effort. As he used two complex theorists to explain Bohr, I am using Bohr to explain three arguably complex theorists, treating Bohr more as a way to ask questions than as a broad answer. Bohr's foregrounding of the human in the highest sense, the ethical, that characterizes much of his later writing, is not trivial. One factor clear in Bohr is science is a means to an end. More broadly, he not only recognizes but also actively seeks diversity—of epistemologies, of nation-states, and of culture itself.

Therefore, I have chosen Bohr's complementarity as a way to both decrypt and combine the following "post Enlightenment" thinkers' respective responses to Enlightenment science, that enterprise emerging fitfully in the sixteenth and seventeenth centuries. By the early twentieth century, that science, having permeated the very consciousness of Western culture, approached what could be called of crisis of knowing. Across a continuum of fields, that which had come to be known as "science" seemed to have reached a critical mass of inadequacy of representation. From the extremes of its extension (as in literature and politics), to its narrowest application in the so-called "hard

sciences" (as in physics and mathematics), the epistemological frame, brought together and articulated in the Principia, seemed to demand new forms of response-ability.

Walter Benjamin: Ad Astra Per Aspera; Ad Aspera Per Astra

Sometime between 1924 and 1928, Walter Benjamin writes:

> Kepler, Copernicus, and Tycho Brahe were certainly not driven by scientific impulses alone. All the same, the exclusive emphasis on an optical connection to the universe, to which astronomy quickly led, contained a portent of what was to come. The ancients' intercourse with the cosmos had been different: the ecstatic trance. For it is in this experience alone that we gain certain knowledge of what is nearest to us, and never of one without the other. This means, however, that man can be in ecstatic trance with the cosmos only communally. It is the dangerous error of modern man to consign it to the individual as the poetic rapture of starry nights. It is not; its hour strikes again and again, and then neither nations nor generations can escape it, as was made terribly clear by the last war, which was an attempt at a new and unprecedented commingling with the cosmic powers. (*To the Planetarium* 92-93)

This is a curious passage. Benjamin—literary critic, Marxist theorist, and Judaic theologian— combines in it an implied history of science, a relational definition of the human and the cosmos, and a critique of modernity's emphasis on the individual. And "combines" is a tragically inadequate verb to describe his method. His history of science, aphorized in this passage but elaborated elsewhere, is a history of loss of experience. In the above passage, not only the ancients, those certainly premodern, but even the earliest

modernists—"Kepler, Copernicus, and Tycho Brahe"—are motivated by a desire for not just an individual human but a collective coupling with the physical world. Important here is "ocularity:" the reduction of experience, grasped as a sensory whole, now becomes a single sense—vision, that which is most distancing. The move in part is from an experience of deep metaphor, a whole-for-whole substitution of things-in-themselves as a gestalt of perception, to the superficial report of metonymy, where the part, that which can be seen, re-presents the whole. Note Benjamin's language to describe the relationship between the cosmos and the human—"intercourse," and "commingling," the first term organic, intimate, sexual, noetic, the second term distancing in its hint of chemical reaction, less a fulfillment of than a subverted desire for a kind of completeness, a drawing to an isolate analog of a communal experience in which we once gained "certain knowledge of what is nearest to us, and never of one without the other."

Benjamin's phrase "never the one without the other" could be used to describe his critique of modernity's valorization of the individual as well as his overall "critical" approach. In the case of his critique on the Enlightenment's focus on the individual, Benjamin consistently argues for recognition of both the general phenomena of increasing isolation of the person and the material consequences of such isolation: the unspeakable horror of the modern at its most material, the machined nightmare of World War One ("Storyteller"). "Never the one without the other," applied to Benjamin's overall approach underscores his more-than-dialectical stance towards ostensibly competing systems of knowing, such as radical Judaic mysticism and equally as radical Marxist materialism. Like Bohr, Benjamin is both exposing and responding to modernity's epistemological inadequacy, seeing in "progress" not a process to be

celebrated but one to be lamented. Progress, Benjamin maintains in "Thesis IX" of "Theses on a Philosophy of History," is a storm that "irresistibly propels" the angel of history "into the future while his back is turned, while the pile of debris before him grow skywards" (258).

However one describes Benjamin's response to the limits of modernity, it isn't "simple," either in method or in revelation. Consider the following from Benjamin's "Thesis XVIII" from "Theses on the Philosophy of History:"

> Historicism concerns itself with establishing a causal connection between various moments in history. But no fact that is a cause is for that reason historical. It becomes historical posthumously, by events that may be separated from it by thousands of years. A historian who takes this as a point of departure stops telling the sequence of events like the beads on a rosary. Instead, he grasps the constellation, which his own era has formed with a definite earlier one. Thus, he establishes a conception of the present as the "time of the now" which is shot through with chips of Messianic time. (263)

In this short, maddening paragraph, Benjamin asserts the totality of his system—the inadequacy of efforts to simplify understanding by an application of linear causality to "account for" human history, and the response-ability of reframing understanding as a constellation of forces, factors, and influences. In part, the conceptual error of "homogenous time" contributes to this mistaken approach to history ("Thesis XVII" 262), the very concept of time upon which Newtonian science is based. Benjamin's "constellation" goes beyond providing a kind of collage of determinants: the historian

engages in an active creation, an ongoing collective salvation, "conceiving" a present characterized by moments of opportunity to recover interconnections, in which "homogenous time" is disrupted. For Benjamin, this experience of linear time stoppage is a requisite stance in order to invite a "messianic moment" in which, in the case of history, one recognizes the fact outside the oppression of its interpretive frames. Critically, one captures, in that moment, a recognition of the interpretive frames themselves:

> Thinking involves not only the flow of thoughts but their arrest as well. Where thinking suddenly stops in a configuration pregnant with tension, it gives that configuration a shock, by which it crystallizes into a monad. A historical materialist approaches a historical subject only when he encounters it as a monad. In this structure he recognizes the sign of a messianic cessation of happening, or, put differently, a revolutionary stance in the fight for the oppressed past. He takes cognizance of it in order to blast a specific era out of the homogenous course of history. ("Thesis 17" 262-263)

Benjamin's Leibnitzian monad is not as much a simplification as it is a disruption: the monad, taken to be a unit of consciousness, glitters into awareness through the historian's thwarting of its flow in time. "Progress" and "homogenous time" are more than erroneous concepts: they are conceptual shackles that enslave the masses of moments. The complex constellatory relationships of the monad to other factors aren't dispelled; the monad, Benjamin seems to be saying, is conscious to the extent its formerly hidden-in-the-time-stream meanings are allowed to break free of the illusion of linear progress. One "saves" the moment, rescuing it, raising it from the death of assimilation

into a context that enslaves. Assimilation, in a Piagetian sense, is an apt interpretative frame: the fact is not just denied its alternative description; it is distorted to the end of reaffirming its oppressive context, which for Benjamin is also a context of oppression. Additionally, this epistemological effort breaks with a simple sense of time itself, creating time instead that is full, heterogeneous, and complex with meaning. The past itself is humanized via materialization, seen as even "oppressed." Yet, alternatively, the human is saved as well, collectively raised from the dead, as the messianic act allows a "revolutionary" re-cognition of the fact. Historical "Truth," in this method, is neither deterministic nor teleological. Instead, it—pardon the expression—involves a complex determination of the teleology of the now.

Consider in contrast to Benjamin's complex manner of configuring truth the following, Newton's first rule of consequence from the Principia:

> Rule one: *No more causes of natural things shall be admitted than are both true and sufficient to explain their phenomena.*
>
> As the philosophers say: Nature does nothing in vain. And more causes are in vain when fewer suffice. For nature is simple and does not indulge in the luxury of superfluous causes. [italics Newton's] (794)

In the above, Newton is asserting formally Enlightenment science's characteristic of simplicity, or parsimony, a concept generally credited to William of Occam, who developed his now famous "Razor" to describe his commitment to the belief that the simplest explanation is always the best. Certainly, Newton's deployment of the idea in the Principia is overtly limited to conducting science on the "natural" world, or at least he is not explicitly extending it to the "social," as in a "science" of history for

example. Yet simplicity, Benjamin seems to assume from the outset, is not only a primary characteristic of "modern" historicism but also historicism's fatal flaw—the assumption of a "simple" progression of historical facts, counted "like beads on a rosary." "Beads on a rosary," as well, is no innocent image: Modernism is akin to the mother church, its ostensible "historians" priests droning a mindless prayer, sanctifying linear progress.

Like Bohr, Benjamin expands, rather than just displaces, what could be called the epistemological frame. Simplicity, Benjamin seems to be saying, is not only limited as a representational rule: it is the very crucial limiting factor, preventing adequate representation. Both homogenous time and linear causality reflect simplicity's limitations. Benjamin's "constellation," as response to simplicity itself as a rule of epistemology, is an attempt to complicate the representation, to recapture a lost wholeness that is at the root of "experience" versus "information." In " Storyteller," Benjamin elaborates:

> Villemessant, …characterized the nature of information in a famous formulation: "To my readers," he used to say, " An attic fire in the Latin Quarter is more important than a revolution in Madrid. " This makes it strikingly clear that it is not longer intelligence coming from afar, but the information which provides a handle for what is nearest that gets the readiest hearing. The intelligence that came from afar—whether the spatial kind of foreign countries or the temporal kind of tradition—possessed an authority which gave it validity, even when it was not subject to verification. Information, however, lays claim to prompt verifiability.

> The prime requirement is that it appear "understandable in itself." Often it is no more exact than the intelligence of earlier centuries was. But while the latter was inclined to borrow from the miraculous, it is indispensable for information to sound plausible. (88-89)

In a manner, the shift Benjamin is describing is in verbs for not just the relationship between human and language but that between human, language, and things-in-themselves. Simply, the move is from re-late to in-form, and the shift in genre is from the complex and multilayered "story" to the simple and transparent "report." For Benjamin, to tell a story is to provide a moment of participation, where "facts" are less "truths" than means to an ongoing act of collective "truthing." At its best, experience *of and as* storytelling invites Wisdom—the "epic side of truth" ("Storyteller" 87). No facts are simple in this system. They are just part of a larger effort to make intelligible – and oddly co-create—the "web" that binds us together. Information, in contrast, is simple, but that simplicity comes at the cost of descriptions of inter-relations: one doesn't "listen" to information, as in Benjamin's description of the story, but rather one is merely—even simply—filled with information, so wrenched from experience that meaningfulness is reduced to that which is merely closest materially.

Significantly, Benjamin's expansion of the epistemological frame involves the most intriguing—and perplexing—aspects of his "theory." Unlike so many associated with the Frankfurt School, from Adorno, to Marcuse, to Habermas, Benjamin is both—simultaneously, alternatively, and coin-spinningly—a theologian and historical materialist. The first of his "Theses" on a philosophy of history cleverly makes the point. In it, Benjamin describes a legendary automaton, dressed as a hookah-puffing Turk,

capable of beating all chess players. However, the real power behind the automaton is hidden under the table by a system of mirrors:

> A little hunchback who was an expert chess player sat inside and guided the puppet's hands by means of strings. One can imagine a philosophical counterpart to this device. The puppet called "historical materialism" is to win all the time. It can easily be a match for anyone if it enlists the services of theology, which today, as we know, is wizened and has to keep at of sight. (253)

Unlike Bohr's complementarity, where systems of representation are arranged horizontally, Benjamin is describing a peculiar vertical system of systems, in which materialism hides the intelligence behind its hand: the "wizened" theology, the "little hunchback." This double move of hiding from sight while affirming theology's critical role in providing the "intelligence" behind historical materialism may account for many past and current appropriations of Benjamin's work, which tend to highlight the Marxist aspects. Benjamin, it could be said, hid his wizened metaphysics under the table too well, providing ready—and so frequently lyrical—quotes to shore up a weary Marxism while failing to provide a manner in which to engage, as Benjamin himself had done, with ideas: artfully juxtaposing the systems of mysticism and materialism in productive denial of contradiction.

Benjamin, it should be reiterated, is not offering a traditional "physical" description and explanation of the world but rather a "constellation" of possibilities for understanding the world. That world from the outset is a human world, where the role of the "tiny fragile human body" is not just noted as a "fact" but is reinscribed as the focus

of inquiry—and, interestingly, as the mystical and material "source" of all knowing. In contrast, Werner Heisenberg was a physicist, working directly and indirectly with Bohr, addressing one of Newton's central concerns: the nature of light in order to shed light on "nature."

Werner Heisenberg: Uncertainty of Generalization and the Generalization of Uncertainty

Newton's second and third Rules of Consequence stress Enlightenment science's principle of generalization. Newton writes in the Principia:

> Rule 2 Therefore the causes assigned to natural effects of the same kind must be, so far as possible, the same.
>
> Rule 3 Those qualities of bodies that cannot be intended and remitted [i.e., qualities that cannot be increased or diminished] and that belong to all bodies on which experiments can be made should be taken as qualities of all bodies universally. (795)

These two rules offer a purity of explanation, a clear causality applicable across circumstances. What generalizability allows for is a global understanding of localized phenomena. To effect such a conceptualization, generalizability requires a systematic exclusion of the human as determinant in the reality equation. The experiment is a very special means to the end of deriving generalizable laws of causality. In a manner, the experiment as a method of observation could be described as an activity in which a scientist carefully maintains a sharp split between subject and object via experimental "control," and then manipulates potentially universal causal elements to both test and generate laws. Significantly, the experiment is the purest method of science, mainly

because it objectifies, literally dehumanizes an "fact," thereby reaching the apex of C. S. Peirce's "method of science:" "It is necessary that a method should be found by which our beliefs are determined by nothing human, but by some external permanency, something upon which our thinking has no effect" (Buschler 18.) Frank Kerlinger, in Foundations of Behavioral Research, says this stance of "self-correction" for determining a "reality outside the scientist's personal beliefs, perceptions, biases, values, attitudes, and emotions" is perhaps best expressed by the word "objectivity" (7).

Until the early twentieth century, most scientists in physics assumed such a strict objectivity, and a concomitant generalizability of laws derived from structured observations of the physical world. Responding to a set of findings in which the competing theories concerning light, wave and light-quanta, were both demonstrable experimentally, Werner Heisenberg developed what has come to be known as "the Uncertainty Principle," which in its simplest form asserts the unknowability of quantum reality before measurement. A number of figures were involved in setting the stage for Heisenberg's development of the uncertainty principle. Schrödinger's attempted resolution, for example, offered an explanation based upon equation of the wave function with the density of charge (Whitaker138-143). In response, Max Born demonstrated that Schrödinger's equation only worked if it were treated as calculating the probability of an electron's location. The replacement of "certainty" with "probability" was at the crux of the dilemma but in a maddening way: the observer herself realized the probability in the moment of observation. In 1929, Werner Heisenberg said the following at the first of his series of lectures at the University of Chicago on the "Physical Principles of Quantum Theory":

> Although the theory of relativity makes the greatest demands on the ability for abstract thought, still it fulfills the traditional requirements of science in so far as it permits a division of the world into subject and object (observer and observed) and hence a clear formulation of the law of causality. This is the very point at which the difficulties of atomic theory begin…. in classical physical theories it has always been assumed that this interaction is negligibly small, or else that its effect can be eliminated from the result based on calculations from the "control" experiments. This assumption is not permissible in atomic physics: the interaction between observer and observed causes uncontrollable and large changes in the system being observed, because of the discontinuous changes characteristic of atomic processes. (The Physical Principles of Quantum Theory 2-3)

In this statement Heisenberg is directly acknowledging the epistemological inadequacy of classical physics. At issue, as he indicates, is both causality and the subject-object split underlying empirical science. What has not failed is the structured observation itself: the experiment. Experiments work, consistently showing what could be called a global law of localized causality. However, what constitutes "causality" itself, what can be expressed as simple laws generalizability to a host of phenomena, is in dispute. Classical physics not only maintains an observer is isolated from the phenomenon under investigation: it draws its authority from that principle of "rigorous" objectivity. The situation is beyond just a difficulty in controlling for the influence of the observer: the observer's relationship with the phenomena "causes uncontrollable and large changes in the system." Einstein, generally treated as a radical theorizer, comes off

as the most resistant to questioning traditional science's epistemological inadequacy suggested by the quantum physical experiments, referring to the observer effect as "spooky action-at-a-distance" (Jammer 181-189) and arguing repeatedly with physicists such as Bohr over the inappropriateness of replacing certainty with probability (Whittaker 239-243).

What is most interesting about Heisenberg's and other's responses to the epistemological inadequacy of Enlightenment science is that it is directly related to the reintroduction of the human into the system of knowledge, quite literally as the experimenter, and quasi-literally, as the "causative" factor extended by the experimental apparatus. For Heisenberg, what emerges is the "uncertainty principle," which he also calls "indeterminacy." Simply, the physicist can measure either the position of a particle or its momentum. Before measurement, the quantum exists in an indeterminate state—a "probability wave packet" that is "collapsed" into reality when measured, also known as the "Projection Postulate" (Whitaker 195). This necessarily reintroduces the human into the scheme of things, but in a manner that less dispels objectivity and replaces it with subjectivity than one in which the very opposition "subjective-objective" no longer holds:

> In classical physics science started from the belief - or should one say from the illusion? - that we could describe the world or at least parts of the world without any reference to ourselves. This is actually possible to a large extent. We know that the city of London exists whether we see it or not. It may be said that classical physics is just that idealisation in which we can speak about parts of the world without any reference to ourselves. Its success has led to the general ideal of an objective description of the

> world. Objectivity has become the first criterion for the value of any scientific result. . . . Certainly quantum theory does not contain genuine subjective features; it does not introduce the mind of the physicist as a part of the atomic event. But it starts from the division of the world into the 'object' and the rest of the world, and from the fact that at least for the rest of the world we use the classical concepts in our description. This division is arbitrary and historically a direct consequence of our scientific method; the use of the classical concepts is finally a consequence of the general human way of thinking. But this is already a reference to ourselves and in so far our description is not completely objective. ("The Copenhagen Interpretation of Quantum Theory")

Notice Heisenberg's seeming vacillation: on the one hand, objective reality exists—London is there, of course, that metaphoric tree continues to fall in the forest whether observed or not. Indeed, objective reality has served us well, and has become "the first criterion for the value of any scientific result." On the other hand, the separation of world into subject and object is "arbitrary"—an "historical" consequence of the success of representation of the scientific method, more a heuristic than an algorithm, one that has worked again and again, not only at accurately representing the "lived in" level of the physical world but also as a kind of "test" of the fancy theorizing and experiments of the scientist. Objectivity, as in the radical separation of observers from observed, is the very starting point of experimentation, even in the quantum realm. But what classical objectivity isn't,

and what is revealed by the findings contextualized under the term "uncertainty," is an *a priori*, Kantian rule.

With Heisenberg's uncertain response, Kant's entire system is undermined, with the worlds of the *noumenal* and the *phenomenal* convoluted, combined, and utterly complicated. Heisenberg maintains that after the uncertainty principle is incorporated into our understanding of the physical world, then:

> Kant's arguments for the a priori character of the law of causality no longer apply…. A similar discussion could be given on the a priori character of space and time as forms of intuition. The result would be the same. The a priori concepts which Kant considered an undisputable truth are no longer contained in the scientific system of modern physics. ("The Development of Philosophical Ideas")

Significantly what Heisenberg implies with his rejection of a Kantian *a priori* frame, along with admission of the productivity of objective classical representations, is that extension of the complications of the objective-subjective opposition derived from quantum physics could also function as a heuristic for framing observations. That is, the implication left is that the nuanced reintroduction of the human into the equation for reality necessary for resolution of the quantum dilemma could offer possibilities for a larger reframing of scientific epistemology itself, if not for general epistemology.

Though not to the extent Bohr extended his complementarity, Heisenberg does offer interesting ideas for expansion, and not displacement of, the epistemological frame of Enlightenment science. Just as with Bohr, the expansion or modification of epistemology is intimately related to the constraints of language:

> It is only after attempting to fit this fundamental complementarity of space-time description and causality into one's conceptual scheme that one is in the position to judge the degree of consistency of the methods of quantum theory (particularly of the transform theory). To mold our thoughts and language to agree with the observed facts of atomic physics is a very difficult task, as it was with the case of relativity theory. In the case of the former, it proved advantageous to return to the older philosophical discussions of the problems of space and time. In the same way it is now profitable to review the fundamental discussions so important to epistemology, of the difficulty of separating the subjective and objective aspects of the world. Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of past centuries. At that time these abstractions could be disregarded as mere mental exercises by those scientists whose only concern was with reality, but today we are compelled by the refinements of experimental art to consider them seriously. (The Physical Principles of Quantum Theory 65)

Heisenberg is suggesting, between long passages in which he traces the genealogy of the mathematics underlying the uncertainty relations, that a quasi-scholastic effort may

be required to provide an effective manner of understanding "modern science." Specifically, he is brushing the modernists' "make it new!" commandment against the grain, noting almost as an aside that "the philosophy of past centuries" should be taken "seriously" as it hasn't been with "scientists whose only concern was with reality." One cannot but think of Newton's "hidden" work both in alchemy and theology, where the ideas of the ancients were valorized and where, in the case of alchemy, the rule of the "experimenter" was considered not as a potential site of "interference" with transmutation, but as a co-determinant, more aptly as part of "the interaction between observer and observed [that] causes uncontrollable and large changes in the system being observed." Perhaps most intriguing in the above quote is Heisenberg's use of the term "reality": usually, it's a mark of a good scientist to be concerned with reality.

However, it seems Heisenberg is trying to describe a better scientist—one concerned not with reality but with changing the definition of how we come to know reality. Perplexingly, Heisenberg's uncertainty relations seem more to describe reality than to explain it. Just as Benjamin's "constellation" as response to simplicity could be framed as a Bohrian complementarity, so too can Heisenberg's "uncertainty" be framed as a complement to science's generalizability. As with Benjamin's, Heisenberg's response involves a recognition of modernity's limits in accurate representation, the need to reintroduce the human, and the expansion of the epistemological frame. Part of Heisenberg's studies, however, involved a specialized area of "knowing" called mathematics, specifically in his case, Hamiltonian matrix algebra. One of Newton's greatest accomplishments was his combining of structured observation, theory, and mathematics in order to provide a means to triangulate on reality. Quantum physics fits

this triangulation as well—the structured observations of the experiments, the theories of uncertainty and complementarity, and a math that reflects the probabilistic nature of the quantum world.

Our final thinker, Kurt Gödel, looks neither to complicate the ideal of simplicity in science nor to demonstrate the inadequacy of traditional generalization. Instead, he is responding to Enlightenment's science's third characteristic—verification—and he takes on the very language of truth, mathematics itself.

Kurt Gödel: Incomplete Math and the Math of (In)completion

In 1931, Kurt Gödel wrote the following in his "On Formally Undecidable Propositions of *Principia Mathematica* and Related Systems,"

> The development of mathematics towards greater precision has is well known, to the formalization of large tracts of it, so that one can prove any theorem using anything but a few mechanical rules. Then most comprehensive formal systems that have been set up hitherto are the system Principia mathematica on the one hand and the Zermelo-Frankl axiom system of set theory (further developed by J. von Neumann) on the other. These two systems are so comprehensive that in them all method of proof today used in mathematics are formalized, that is reduced, to a few axioms and rules of inference. One might therefore conjecture that these axioms and rules of inference are sufficient to decide *any* mathematical question that can at all be formally expressed in these systems. It will be shown below that this is not the case, that on the contrary there are in the two systems relatively simple problems in the theory of integers that cannot be

> decided on the basis of the axioms. The situation is not in anyway due to the special nature of the system that have been set up but holds for a wide class of formal systems. (145)

In these few lines, written in a lucid and unostentatious prose, Kurt Gödel, metamathematician, theoretical physicist, and logician, managed to outline a discovery concerning the very heart of mathematical epistemology: the determination of the "truth" of a statement. As simply as can be stated, Gödel determines, using strict and rigorous application of the rules of formal logic, that there will always be a true but unprovable statement outside any system of logic. The two axiom systems to which Gödel refers—the *Principia Mathematica* system of Bertrand Russell and A. N. Whitehead and the Zermelo-Frankl/von Neumann system – form, at the time of Gödel's writing, the basis for all but the most experimental mathematical systems used by scientists in a variety of fields. Note, however, Gödel's extension of his findings: it will hold for a "wide class of formal systems." Gödel, so frequently careful in expression, is very conservative in that simple assertion: the implications of Gödel's incompleteness theorems, as his discovery has come to be called, is a dramatic expression of the epistemological inadequacy of modern science.

To trace the real epistemological consequence of his findings one need look no further than Boyer's popular The History of Mathematics:

> In its implications the discovery by Gödel of undecidability as was disturbing as the disclosure by Hippasus of incommensurable magnitudes, for it appears to foredoom hope of mathematical certitude through the use of obvious methods. Perhaps doomed as a result, is the ideal of science—

> to devise a set of axioms from which all phenomena of the natural world can be deduced. Nevertheless, mathematician and scientists have taken the blow in stride. . . . .(611)

Note Boyer's apocalyptic language—"disturbing," "foredoomed," "doomed as a result," "the blow"—it is as if it is the end of the mathematical world. Gödel has left a blasted heath of "certitude," it seems, and the very ideal of science, a rule set capable of universal verification, is fundamentally impossible. Just as Benjamin "responded" to simplicity, and Heisenberg to generalization, Gödel is responding to the last, and perhaps most critical, characteristic of Enlightenment science: verification. Consider Newton's last Rule of Reasoning in the Principia:

> Rule 4—In experimental philosophy, propositions gathered from phenomena by induction should be considered nearly or exactly true notwithstanding any contrary hypotheses, until other phenomena make such propositions either more exact or liable to exceptions. (796)

There it is—the rule governing the determination of the truth of "propositions gathered from phenomena." Newton is demanding verification, specifically here for the construction of propositions by induction—setting up structured observations of things-in-themselves to both determine and test "rules." However, things-in-themselves, even in terms of their empirical observations, are secondary to their inducted characteristics: Newton is describing only the base level of verification, that of proposition development. Gödel is responding to the next level of verification—the manipulation of those propositions within a formalized system of truth-value determination. In short, Gödel's studies involve attempts to develop an ideal mathematics, a symbolic logic capable of

determining the truth of any statement. Gödel's study of the possibility of such an ideal math, using metamathematics, which "is not concerned with the symbolism and operations of arithmetic, but with the interpretation of these signs and rules" (Boyer 612), offers up both a qualified semiotic method to study math and what could be called a qualified semiotic interpretation: a re-introduction of the human into the mix.

The question as to what extent Gödel's incompleteness directly indicates self referentiality, that is, provides proof of a human as co-determinant, hinges on the idea of a truth outside the system of logic. The "outsideness" of the unprovable but true statement suggests the statement is inside the human, which is trivial at one level, but not when the statement's truth and unprovability are "determined" by the human. The human does more than contain the statement—the human necessarily constructs the statement and somehow determines the statement's truth. In most cases, the self-referentiality argument is taken from what has become the almost clichéd non mathematical demonstration of incompleteness: start with a Universal Truth Machine (UTM), which is capable of unerringly determining the truth of statements. Truth, with such a machine, then is that which can be proven, the basic equation.

Now, feed statement, call it G for Gödel, into the machine. We now have statement G(UTM). If G(UTM) is indicated true, then the machine is lying; that is, the machine—the internally consistent logic—is not a Universal truth machine, because truth and provability is the basic equation for UTM's functioning, and it therefore can't agree to the statement's truth because it overtly denies the basic equation. However, if G(UTM) is deemed false, then it violates the first part of its definition—that it is true.

To be brief, what this all means is that formal logic's apex, math (this includes "maths" as it applies to all formalized systems for handling number sets), is incomplete in and of itself, but determination of truths outside the system(s) is still possible. Self-referentiality, as indicated in the above nonmathematical example, comes in part from the G, the deployment of Gödel as the statement. One could, in fact, replace G with "I" for "incomplete" and the example would still work. However, whatever symbol is used to refer to the statement, self-referentiality necessarily enters the system, as the generation of unprovable statements themselves requires not a formal mathematical system but an intuitionist one. Gödel's overall position, despite the unsettling nature of his incompleteness system, is decidedly realist, that is, Platonist. For the realists, the existence of mathematical objects is as "real" as the existence of physical objects. Other mathematicians, called variously "constructivist," "nominalist," and "predicativist," aimed at placing "mathematics in a conventionalist role as the 'syntax of language,' thus separating it from physical science, which itself was to rest finally on empirical findings" ("Gödel's Life and Works" 29). The latter group, by approaching mathematics as one would a language, seems at first glance closer than Gödel to offering a point of conceptual insertion of the human into the reality equation.

Undeniably, Gödel's interpretation of his own theorem is that it supports his sense of the independence of mathematical objects from our ideas, constructions, and thoughts. Mathematical objects, such as his "true but unprovable" propositions, require "mathematical intuition" to find "the source of genuine mathematical knowledge. The intuition can be cultivated through a deep study of the subject" ("Gödel's Life and Work" 32). That intuition, Gödel maintains, is in addition to formalized testing of propositions.

However, what still remains in Gödel's system of systems is the human as an even more complex and active participant in knowledge perception, where a pure logic denied is also a chance for development of a cluster of logics. That those clusters are framed as systems to "sense" and not "construct" mathematical reality does not eliminate the human from the equation. Rather, Gödel highlights the role of the human as a higher-order perceiver of mathematical reality, where, almost in contrast to Heisenberg, the very positivity of a mathematical object, its ability to have a reality imperceptible by a system of mathematical sensing such as Russell's and Whitehead's, increases the human's power. Choice of the real is a choice between either formally verifying or intuitionistically sensing the mathematical object. Intuitionist approaches to math are not simply feeling a proposition. Rather the term refers to an alternative approach to math that allows for presentation of propositions without, among other things, an initial demand for a strict formalist consistency. Prior to Gödel, such approaches were not uncommon, but the move had always been to treat those propositions as hypotheses and then test those intuitionist statements within a formal system. Gödel's incompleteness theorem puts the human in an interesting place in epistemology: the human actively chooses between hitherto hierarchically ranked systems of verification, with a Bohrian "exhaustive description" of the world of mathematical objects possible only through an interdependent yet mutually exclusive application of both formal mathematical approaches and intuitionistic approaches.

Although Gödel devoutly argues against the idea of mathematics as a constructive language, he does not address a possible implication of his incompleteness theorem for language itself as a means to knowledge. To the extent that the ideal of an argument is

based upon modeling the "pure" truth validation of mathematics, what is suggested by a realization that that ideal is not just temporarily but definitively incapable of perfect knowing?

Certainly the argument structure of analytic philosophy is mathematical in its basic parameters, whether math is viewed as the model or the apex. As varying shades of mathematically based logic systems, all systems of argument are necessarily, in light of Gödel's theorem, incapable of proving all statements. In fact, as with the math, a logic's very "truth-ability" may be well tested by its inability to prove true but unprovable statements. And if that is so, then the true but unprovable statement—and its very outsideness of the logic—is foundational for the logic to work. As Gödel notes in his "Postscript" to the notes of the Second Conference on Epistemology of the Exact Sciences in 1930:

> The assertion of the consistency of the system in question itself belongs to the propositions undecidable in that system. That is, a consistency proof for one of these systems can be carried out only by means of inference that are not formalized in the system itself. For a system in which all finitary forms of proof are formalized, a finitary consistency proof, such as the formalists seek, would thus be altogether impossible. (205)

The editors of Erkenntnis, who had accepted Gödel's paper on undecidability, but had not released publication before the conference, requested Gödel's "Postscript." What the "Postscript" clarifies, in part, are comments Gödel made concerning both undecidability and formal consistency. What Gödel is asserting above is not just the impossibility of a system capable of proving all statements, but more critically, the very verifiability of a

system's consistency is dependent upon such statements. Thus, a verification system can never verify itself, that is, use its own means to determine the truth-value determination power of those means. Instead, it must appeal to the authority not just of a different system but more specifically to a system that it cannot verify.

The key to Gödel, perhaps, is to note how the three characteristics of a post-modern response combine in his system. His recognition of formal systems' inadequacy also becomes the basis for his expansion, and not displacement, of the epistemological frame. In other words, taken together, unprovable true statements and formal mathematical systems provide in their inter-relationship an overarching possibility of sensing the "wholeness" of the world of mathematical objects. The critical term here is "inter-relationship," conceived as functioning as a form of Bohrian complementarity. The very consistency of the logic system is dependent upon the failure to prove the undecidable, and the truth of the undecidable statement is mutually exclusive of its proof from the formalized system.

That complementary relationship extends to the idea of "exhaustive description" of the world of mathematical objects, where the two means, formal and intuitionist, mutually exclusive yet interdependent, are both needed to provide a means of complete verification, of both objects and systems of object recognition. Critically, the role of the human in this expansion of the epistemological frame is that of completionist: the one system of truth-value determination in which the incompleteness theorem does not hold is the human herself.

Towards a Human(e) Science and a Science of the Human

Almost tentatively, Foucault writes in "What is the Enlightenment?":

> I wonder whether we may not envisage modernity as an attitude rather than a period of history. And by attitude, I mean a mode of relating to contemporary reality; a voluntary choice made by certain people; in the end, a way of thinking and feeling; a way, too, of acting and behaving that at one and the same time marks a relation of belonging and presents itself as a task. No doubt, a bit like what the Greeks called an ethos. And consequently, rather than seeking to distinguish the "modern" era from the "premodern" or "postmodern," I think it would be more useful to try to find out the attitude of modernity, ever since its formation, as found itself struggling with attitudes of "countermodernity." (309-310)

What interests me most about this quote is Foucault's definition of attitude: a "mode of relating to contemporary reality," involving thinking, feeling, and acting, and marking "a relation of belonging." Enlightenment's science's three characteristics—simplicity, generalizability, and verifiability—are, I have assumed from the outset, characteristics of the "attitude" of modernity. Relatedly, I have treated Benjamin, Heisenberg, and Gödel as early examples of what Foucault would call "attitudes of 'countermodernity'" However, what drives Foucault's analysis is also a limit: the ultimate reduction of human activity to expressions of "relations of power." Foucault himself is an example of an attitude of counter-modernity: truth-games, ostensibly unbiased epistemologies, are complicit with at the minimum and disguising at the maximum "power games" ("The Ethics of the Concern for the Self as a Practice of Freedom" 294). Foucault's near equation of power games with truth games suggests he seems to neither replace or nor expand the epistemological frame but rather to displace

the whole idea of epistemology. My sense is, despite Foucault's brilliance, his method is recognizably dialectical, even if forever holding in abeyance a "synthesis." In a larger sense, Foucault responds to Newton's and others' thesis of "unity of truth" with its antithesis, "will to power" under the guise of "will to knowledge," *j'accusedly* problemitizing the Enlightenment's claim to truth while nevertheless offering little by way of functional response.

Not so Benjamin, Heisenberg, and Gödel: in each, in different ways, the move is counter-reductive and more overtly aimed at re-covering "modern" epistemology. Bohr's meta-epistemological frame of complementary allows for not so much a synthesis as a new, and I maintain, productive manner of configuration of knowledge that suggests the possibility of a human(e) science and a science of the human. Conceptually, Bohr's approach invites a description of horizontal levels of application. Benjamin's response to simplicity, constellation, can be framed not as antithetical to simplicity but as a complementarity ensemble, perhaps one that could be called "Holicity." Similarly, Heisenberg's response to generalization, uncertainty, can be framed as the complementarity ensemble "Glocalicity." Finally, Gödel's response to verification, incompleteness, can be framed as the complementarity ensemble "Veraticity." Approaching all phenomena, in this system, would require both "sides" of the complement, as well as the "sides'" interactivity in terms of mutual exclusivity and interdependency. Additionally, each complement calls into question the subject-object split, requiring more a continuum of separation rather than a binary opposition.

Each of the complementarities reflects not so much a description of wholeness but rather a new manner of attempting to capture features of wholeness, whether in the

physical world, the social, or the psychological. All of these complementarities express the three characteristics of what Foucault calls the "attitude of post-modernity," which in my analysis includes recognition of inadequacy of modernity's epistemological frame to account for wholeness, a re-introduction of the human into the equation, and finally, an expansion, not a displacement, of modernity's epistemological frame. Importantly, these complementarities are not answers in themselves but rather conceptual sites for reframing the very questions we ask, along with set of ways to "verify" those answers. In short, these complementarities disrupt the frame of binary opposition, freeing knowledge from the demand for hierarchicalization.

The "importance" of these findings, though, is, like the evidence of the photographic plates that so perplexed twentieth century physicists, only determinable after the fact of their extension to the ethical. It is the ends to which epistemology (ies) is put that provides the final "completeness" theorem, and that end should be, could be, and already is the human. If a principle, a necessary precondition of argument as Aristotle says in On Rhetoric, is not just akin to but a form of a true but unprovable statement, then the full completion is a circle: the principle is the alpha and omega of logic, and its translation via argument into a course of action is the very root of ethics. The science Foucault tracks in his studies of the Greeks was a *techne* of the self, an *ethos,* as he puts it. A problematic *techne*, certainly: though it offers a possibility of liberation, it also, and if one accepts the gist of Foucault's interpretation—more often—subjugates the human. Thus we have the Scientific Management of the human, a *techne* of the self that is characterized by simplicity, generalizability, and verifiability. The human gains and loses in this method of systemizing the self and placement of self into a system: how

powerful our factories and assembly lines, from our production of textiles to our minting of graduate students! Yet how horrifying the literal and figurative "objectifications" conjured by this modern epistemology. From the machining of warfare, to the production-consumption model of "knowledge," modernity, with "science" as my point of interrogation, must be held accountable for and to the human.

The theorists I selected are among those whom, I think, hold modernity accountable. All three move the "human subject" from the periphery of knowledge to the center of knowing: Benjamin's human seizes time itself and stops it; Heisenberg's human turns probability into reality; and Gödel's human completes the inherent—and inhuman—incompleteness of truth-language itself. Such approaches offer examples of a human science, but with the exception of Benjamin, an inherently "humane" science, one driven by its ethical ends, is still elusive.

The answer to the question of a human science, as well as a manner to approach the larger issue of Bohr's desired "unity of knowledge," may be in the extension of these developments to "retranslation" of "category human" itself. To offer as productive definition the human as a constellated subject rather than only as a simple object suggests a "liberating" *techne* for understanding and a *techne* for liberation from a mechanical sense of being. Similarly, to view the human as an active participant in the realization of probabilities, from the most foundational level of "realizing" light, to the semiotic level of "realizing" political potentialities, provides a context for human as having inherent and multi-leveled agency. Finally, to see the human as the penultimate completionist of not just "truth" but of methods of knowledge themselves suggests a stance neither person-to-object, nor self-to-other, nor even person-to-person.

Rather, it suggests a god-to-god rendezvous between people, where all communicative acts have the possibility of being "completions of creation." As Walter Benjamin says, "All higher language is a translation of the lower, until in ultimately clarity the word of God unfolds, which is the unity of this movement made up of language" ("On Language as Such" 332). For Bohr, that "higher language" is always held to the standard of a "common language capable of communicating experience" ("Unity of Knowledge" 81). However, he viewed that task of translation as an ongoing process, as

> an endeavor to achieve harmonious comprehension of ever wider aspects of our situation, recognizing that no experience is definable without a logical frame and that any apparent disharmony can be removed only by an appropriate widening of the conceptual frame. ("Unity of Knowledge" 82)

That comprehension, Bohr writes at the height of the Cold War, always had implied an ethical responsibility. Given the human consequences of "modern" knowledge, that response-ability takes on a new urgency:

> When the fate of all peoples is inseparably connected, . . . collaboration in mutual confidence, based upon appreciation of every aspect of the common human position, is more necessary than ever before in the history of mankind. ("The Unity of Knowledge" 15-16)

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