Unrecoverable Past and Uncertain Present:
Speculative Drama's Fictional Worlds and Nonclassical Scientific Thought

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Abstract

The growing accessibility of quantum mechanics and chaos theory over the past eighty years has opened a new mode of world-creating for dramatists. An increasingly large collection of plays organize their fictional worlds around such scientific concepts as quantum uncertainty and chaotic determinism. This trend is especially noticeable within dramatic texts that emphasize a fictional, not material or metafictional, engagement. These plays construct fictional worlds that reflect the increasingly strange actual world. The dominant theoretical approaches to fictional worlds unfairly treat these plays as primarily metafictional texts, when these texts construct fictional experiences to speculate about everyday ramifications of living in a post-quantum mechanics world. This thesis argues that these texts are best understood as examples of speculative fiction drama, and they speculate about the changes to our understanding of reality implied by contemporary scientific discoveries.

Looking at three plays as exemplary case studies—John Mighton's *Possible Worlds* (1990), Tom Stoppard's *Arcadia* (1993), and Tony Kushner's *Homebody/Kabul* (2001)—this thesis demonstrates that speculative fiction theories can be adapted into fictional worlds analysis, allowing us to analyze these plays as fiction-making texts that offer nonclassical aesthetic experiences. In doing so, this thesis contributes to speculative fiction studies, fictional worlds studies, and the dynamic interdisciplinary dialogue between aesthetic and scientific discourses.

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Introduction

Quantum mechanics has challenged the fundamental theories that previously dominated natural philosophy for hundreds of years. In March of 1927, theoretical physicist Werner Heisenberg boldly declared that the natural world features imprecision at the nanoscopic scale. Many scientists, Einstein loudest amongst them, balked: since Sir Isaac Newton defined the laws of physical motion in the 17th century, science had moved towards greater precision. This upstart principle attacked this epistemic foundation by implying there was a limit to knowledge. Heisenberg's inventive mathematics showed that it was impossible to get a precise measurement of a particle's speed and position simultaneously: precisely measuring one causes the other to become imprecise or, to use Niels Bohr's preferred term, uncertain. Since Heisenberg proposed his uncertainty principle, experiments have consistently ratified it: the physical world seems to shy away from certainty. This anti-deterministic concept transformed physics and mathematics, and the 20th century saw strange theories ranging from multi-world quantum mechanics to deterministic chaos. This new way of thinking about science, called "nonclassical" by science writer Arkady Plotnitsky, drove a wedge between the observable described by Newton's laws and the strange reality found at very small (quantum) and very large (chaos) scales. These ideas have shaped how philosophers and scientists approach nature. They have also changed how many people see, make art, and write drama.

In this thesis, I hypothesize that a subset of contemporary drama reflects this nonclassical vision of the world, mirroring quantum mechanics and chaos theory. These plays construct worlds wherein beings and spaces are uncertain, as in the uncertainty principle, and chaos replaces the classical principle of cause and effect, as in chaos theory. This thesis argues that these plays are best understood as a type of speculative fiction drama

(hereafter speculative drama). Speculative fiction scholars theorize about strange worlds filled with monsters or science fictional technologies, and this thesis adapts those theories to the equally strange worlds that mirror quantum mechanics and chaos theory.

To prove that speculative fiction theories can illuminate these nonclassical dramatic worlds, I treat three speculative dramas—John Mighton's *Possible Worlds*, Tom Stoppard's *Arcadia*, and Tony Kushner's *Homebody/Kabul*—through the paradigm of fictional worlds. Quantum mechanics and chaos theory both aim to describe how the world works; the fictional worlds paradigm similarly aims to describe how the worlds found in fiction work. The case studies demonstrate how quantum mechanics and chaos theory have changed how some dramatists view the world and, subsequently, construct fictional worlds in their drama.

The prevailing fictional worlds paradigms adequately describe fictional worlds that appear Newtonian, but they struggle with these nonclassical worlds. Newton's classical mechanics describes the world as a machine: a set of linear systems that offers predictable outcomes because identical conditions lead to identical results. The machine exists in "absolute space" that is unchanging and traversable by motion, and "absolute time" that moves uniformly into the future regardless of what happens within it (Rynasiewicz). Every event has its recoverable cause and is the cause of the next predictable event. These Newtonian mechanics describe the everyday world*:* what one can see through classical apparatuses such as eyes and optic lenses. Since Aristotle's *Poetics*, theories of fictional worlds have heavily relied on assumptions about causality, probability, and certainty reminiscent of Newton's orderly world. These assumptions still reign in contemporary approaches, such as possible-worlds fiction theory (hereafter PW fiction theory). This complication is explored thoroughly in chapter 1.

Comparatively, nonclassical scientific thought "makes[s] the unknowable an irreducible part of knowledge" because objects at a very small scale or patterns at a very large one "are seen as being beyond any knowledge or even conception, while, at the same time, affecting what is knowable" (Plotnitsky xiii). According to Niels Bohr, quantum mechanics forced scientists to accept that the universe's most basic building blocks are "*in principle* excluded" from the realm of human knowledge (qtd. Plotnitsky xiii). It is impossible to know everything about an atom because an atom is in principle uncertain. This is a feature of the world, not the result of insufficient measuring apparatuses. Similarly, one cannot recover all the causes of weather nor predict its future because it is in principle causally chaotic. Quantum mechanics and chaos theory describe a nonclassical world characterized by uncertainty, unrecoverable causes, and non-absolute space and time. Subsequently, nonclassical worlds undermine the causality, probability, and certainty anticipated by the dominant theories of fictional worlds. This thesis hypothesizes that existing theories of speculative fiction can be adapted to fictional worlds analysis to account for nonclassical worlds.

Speculative Fiction and Case Studies

Speculative fiction is arguably the most popular commercial genre: from TV's *X-Files* to *Harry Potter* novels and *Warcraft* computer games, popular culture brims with otherworldly lands and supernatural beings. The genre is also notoriously difficult to define. P.L. Thomas argues that most scholars approach speculative fiction with a "know it when you read it" mentality (16): while there are common themes, ethical imperatives, and motifs that pervade the genre, sweeping definitions invariably misrepresent some subset (19). This thesis makes no attempt to develop a sweeping definition of the speculative drama sub-genre.

Instead, it borrows literary theorist Tzvetan Todorov's approach to genre studies to understand speculative drama as a set of common world-building mechanisms.

In his analysis of detective fiction and the fantastic genre, Todorov showcases that genre can be understood as a set of common structural patterns and mechanisms that any text can be compared against (*Prose* 42–43). Todorov's method shows that it is possible to meaningfully examine the speculative fiction aspects of any text. This non-prescriptive approach is especially fruitful for commercial genres because their mechanisms permeate popular culture. Looking at speculative fiction as a set of common mechanisms, this thesis proposes that nonclassical fictional worlds are best understood as speculative fiction worlds (hereafter speculative worlds). Speculative fiction theories can be adapted into the paradigm of fictional worlds analysis to describe the fictional worlds of these texts.

The term speculative fiction was coined in 1889 by critic M.F. Egan to describe stories that ask "what if?" questions about the future (597). Some theorists then adopted the term to describe a subgenre of science fiction that extrapolates about "the effects of new inventions or information" (Merril 9) in strict fictional thought experiments. Others use the term to collect any text that features an alternate world. The first definition prescriptively limits speculative fiction to a modest subset of science fiction: speculative fiction is a type of science fiction that seriously speculates about the potential ramifications of possible future technologies. The second descriptively collects a literary trend, broadly gathering works that emphasize an alternative world's fantastical, science fictional, or horrific elements. Prominent authors Ursula K. Le Guin and Margaret Atwood have publically embodied this back-and-forth: Atwood sees speculative fiction as extrapolation about "things that really could happen but just hadn't completely happened when the authors wrote the books" (6), and Le Guin insinuates that speculative fiction is a general category. I will not try to settle

this dispute, but instead accept speculative fiction as a genre guided by distinct world-building activities: speculative fiction alters the everyday world and then methodically extrapolates on the effects of its alteration.

Literary scholar R.B. Gill offers a definition of speculative fiction that respects the genres' many forms while simultaneously pinning down a common world-building function:

> Speculative fiction envisions a systemically different world in which not only events are different, but causes operate by logics other than normal ones . . . Speculative fiction, then, is not defined by contrast with literary realism . . . [but in] contrast with the operational rules of the normal world. (73)

The worlds of science fiction, fantasy, and horror (among others) are speculative worlds because they systematically deviate from the real world by introducing an operational rule that contrasts with the rules of the real world. This definition of speculative fiction is quite broad and discussions about the genre's boundaries rage. Veronica Hollinger argues that Absurdist and "the most allegorical of experimental fictions" are speculative fiction because of the indisputable presence of operational rules (273); others include African magic realism (S. Thomas) and gender reversals (Rives) as examples of speculative fiction. What appears clear, however, is that scholars largely agree that the speculation does not need to be limited to "things that really could happen" as Atwood suggests. Given the speculation, the process of extrapolation must just be methodical: as explained by Marie McLean, a speculative text must proceed from its initial speculation "by a process of extrapolation […that is] always rule-governed and not the 'free' product of the imaginary" (120).This thesis argues that the unique features of speculative worlds allow dramatists to abandon everyday Newtonian constraints and follow the operating rules of nonclassical science instead. The speculations

made by these texts alter the everyday world by elevating quantum mechanics and/or chaos theory to a noticeable scale for the reader, the characters, or both.

Octavia Butler argues that speculative worlds help writers investigate three questions about the real world—"what if, if only, and if this goes on" (qtd. Pough and Hood 1)—and the plays examined in Chapters 2, 3 and 4's ask these questions about nonclassical science. Many scholars agree that such questions are central to speculative fiction (Pough and Hood; S. Thomas; Rives; Shimkus; Sproule) but they rarely discuss speculative fiction in drama. Two books tackle speculative drama directly, but neither book is interested in the genre's world-creating mechanisms. Ralph Willingham's *Science Fiction and the Theatre* is mostly a historical overview of science fiction on stage, and Patrick Murphy's *Staging the Impossible* focuses on anti-realism as a style. Canadian scholar Scott Duchesne examines speculative drama in several articles, but his work does not aim to define the genre or map out its world-constructing patterns. Despite the lack of scholarship about types of speculative fictional worlds in drama, the genre's disparate material requires a typology to explain why a world that reflects quantum mechanics and one that contains Dracula co-habitat a single genre.

Literary scholars often adapt Todorov's typology of *fantastical worlds* to discuss the worlds of speculative fiction (McLean 118). Todorov describes fantastical worlds on a binary ranging from "the marvellous" to "the uncanny" with "the fantastic" at the centre (*Fantastic* 32–46), and this binary has been expanded by McLean to describe the range of speculative worlds. Marvellous worlds densely saturate the fictional world with speculated (supernatural) and everyday (natural) elements to encourage the reader to accept anything as possible within the world. Such worlds constantly introduce new supernatural objects so the reader can never grasp the operational rules: anything seems possible. Marvellous-fantastic worlds involve a speculated outsider intruding on the everyday world: there is the interaction

between a world of everyday humans and a marvellous world, such as in myths. In fantastic-uncanny worlds, the everyday world is altered by human manipulation or scientific discovery, such as science fictional space travel or Frankenstein experiments. Finally, uncanny worlds are the worlds of gothic horror, where human-seeming horrors intrude into the real world before being dispelled as illusion (McLean 119).

Scientifically nonclassical worlds, the focus of this thesis, fit the uncanny-fantastic banner: they feature an everyday world altered by a scientific speculation. Additionally, the border between the everyday elements and speculated elements is clearly delineated. Every case study play exhibits this fantastic-uncanny sensibility. In choosing case studies, I searched for dense works that evidently "operate by logics other than normal ones" (Gill 73) and seem to approach their internal logic methodically. To avoid translation issues, each play is from the English-speaking world while still representing an international trend: *Possible Worlds* is from Canada, *Arcadia* is from England, and *Homebody/Kabul* is from the USA. The trend is necessarily recent—for example, chaos theory was not accessible to laymen until 1987, when James Gleick's *Chaos: Making a New Science* debuted—and so the oldest play is from 1990.

Most importantly, I wanted to work with writers and plays that represent a wide range of theoretical backgrounds. Mighton holds an MA in philosophy and a Ph.D. in mathematics. Stoppard has no scientific or mathematical training, but built a career dramatically investigating science and logic. Finally, Kushner has never proclaimed an interest in contemporary science, but *Homebody/Kabul* reflects very nonclassical ideas, likely inspired by contemporaneous philosophers. Reflecting their authors' thinking, the first two texts, *Possible Worlds* and *Arcadia*, explicitly mention nonclassical science: they include an expert character who openly discusses relevant theories. *Homebody/Kabul* does not mention

contemporary science, and this play is an opportunity for me to apply the insights gained from the previous case studies to a text that does not disclose that its structure is based on scientific models. These plays hopefully showcase the remarkable speculative mechanisms that construct nonclassical fictional world.

Thesis Structure

The four chapters of this thesis present a summary of the theoretical thought on how to read speculative fiction, and also analyze three case study plays that embody the nonclassical speculative mechanism. As I further demonstrate, each play constructs a nonclassical world which defies categorization by the dominant fictional worlds paradigms. Each case study chapter introduces a new nonclassical scientific theory and expands on its implications before examining how that theory can be borrowed to describe the relevant play's fictional world. To be clear, I do not claim to be an expert in quantum mechanics' or chaos theory's mathematics: however, scientists and science writers alike discuss the ramifications and implications of advanced theories, and these plain-language interpretations are my focus.

Chapter 1 establishes the theoretical framework that allows me to describe fictional worlds without relying on possibility, probability, or necessity. My framework respects the invaluable insights of Aristotle and PW fiction theory, but borrows from speculative fiction studies—Todorov's theory of the fantastic and Darko Suvin's theory of the novum—to describe how the text replaces strict classical expectations with a speculated nonclassical alternative. I meet this goal by: (1) examining the two prevailing approaches to fictional worlds to highlight their incompatibilities with nonclassical structures, (2) introducing speculative fiction theories that theorize how texts convince the reader to accept non-

everyday elements, and (3) establishing space and time (understood using Mikhail Bakhtin's concept of the chronotope), plot, and character as useful categories of analysis.

Chapter 2 examines *Possible Worlds* by mathematician-cum-playwright John Mighton. The play explores the possibility that infinite permutations of the world concurrently exist. This chapter has several goals: first, it tests dramatic probability and PW fiction theory against a text that constructs a nonclassical world to better pinpoint the particular difficulties the previous paradigms meet. After demonstrating that these approaches cannot grapple with *Possible Worlds'* unique spatial chronotope, the chapter introduces the many-worlds interpretation of quantum mechanics: all uncertain quantum possibilities are actualized in discrete spatially disconnected worlds. It then proposes to read *Possible Worlds* as a speculative drama that speculates about the many worlds interpretation. Mighton's ontology-defying dramaturgy is most evident in his management of dramatic space: the play visits many spaces, both onstage and imagined, that are non-traversable, discontinuous, and are incompatible with Newton's absolute vision of space.

Chapter 3 looks at *Arcadia* by Tom Stoppard and its interaction with chaos theory. Stoppard explicitly borrows the structures of deterministic chaos, and characters have dialogue about the theory's ramifications (Stoppard 12). Chaos theory is the mathematical evaluation of systems that seem random, but are actually determined by a complex chain of cause and effect that obfuscates the initial conditions. This is known colloquially as the butterfly effect. The fact that the plot reflects the theory is well-documented (Demastes; Fleming), but this thesis delves into the categories of dramatic character and chronotope to examine how the play's events grow from deterministic chaos instead of "probability and necessity". This is best reflected in Stoppard's utilization of dramatic time: chaos is constructed by showing a single space as it oscillates between two periods of time.

Chapter 4 examines Tony Kushner's *Homebody/Kabul.* In *Homebody/Kabul*, characters, locations, and time-periods are simultaneously dead and alive, free and restricted, transformative and stagnating. While previous scholarship argues that *Homebody/Kabul*'s contradictions are apocalyptic or transformative poetic devices (Philips; Stevenson), I argue that the play exhibits a speculative world that integrates both uncertainty and chaos patterning. Where *Possible Worlds* and *Arcadia* exhibit nonclassical space or time, *Homebody/Kabul* exhibits uncertainty in both axes to undermine the very idea of generating absolute theories at all. *Homebody/Kabul* makes no direct mention of nonclassical science and so the lessons learned from *Possible Worlds* and *Arcadia* will be applied to a dramatic world that is not explicitly speculative. This process helps demonstrate how these scientific theories can be borrowed without forcing unintended structural rigidity onto a dramatic text.

In conclusion, this thesis argues that speculative dramatic texts create fictional worlds that the dominant approach cannot adequately describe. Borrowing theories from speculative fiction studies helps adapt this approach to account for worlds that reflect nonclassical science's uncertainty and chaos. Right now, scholarship tends to discuss fiction as a logical structure—a framework readers use to parse complex fictional references—and this approach makes it difficult to describe worlds devoid of certain states of affairs or deterministic causality. These worlds are not illogical or metafictional, but are guided by different operational rules. These plays reflect postmodernism's concerns about uncertainty and multiplicity while generating meaningful fictional experiences. Examining how these plays construct worlds better illuminates the unique aesthetic experiences offered to contemporary readers who accept a world-view happy with the unknowable and open to uncertainty and chaos.

Chapter 1: Nonclassical Fictional Worlds as Speculative Worlds

Quantum mechanics and chaos theory have become household terms. Most people do not grasp either theory's technical dimensions—many scientists would argue that quantum mechanics is not graspable at all—but terms such as *the uncertainty principle* and *the butterfly effect* have permeated popular culture. Schrödinger's cat, an illustrative explanation of quantum mechanics' implications (described later in this chapter), struck a chord with story-tellers as early as Ursula K. Le Guin's 1974 *Schrödinger's Cat*. Soon, speculative fiction novels such as Douglas Adams' 1987 *Dirk Gently's Holistic Detective Agency* and Terry Pratchett's 1992 *Lords and Ladies* had adapted Schrödinger's cat into comedic situations that assume that the reader is already familiar with the concept. By 2007, *The Big Bang Theory,* now one of the most popular American television sitcoms in history, based weekly episodes around quantum physicists arguing over the difference between string theory and loop quantum gravity. With the butterfly effect, James Gleick's 1987 book *Chaos: The Making of a New Science* is often credited with introducing the idea to a wide audience. Soon after its publication science fiction novels such as Michael Crichton's *Jurassic Park* and Terry Pratchett's *Interesting Times* included chaoticians as characters and direct references to the theory. By 1994 the butterfly effect had worked its way out of science fiction and into popular television: *The Simpsons* structured a Halloween episode "Time and Punishment" around the concept. The popular 1998 German film *Lola Rennt* is a chaos theory thriller, and by 2004 the American film *The Butterfly Effect* had Hollywood stars such as Ashton Kutcher reinforcing the theory's place in popular discourse. Artists in popular culture and beyond are dredging quantum and chaotic concepts up from imperceptible scopes to examine them dramatically, and the real world no longer seems captured by Newton's everyday laws.

Despite this proliferation of nonclassical scientific ideas, the prevailing fictional worlds theories look Newtonian: they expect a text's fictional world to exhibit certainty, regularity, and fixity or else the text "cancels the entire world-making project" and creates "metafiction" instead of fiction (Doležel 165–166). Scientists can describe the quantum world without relying on "metareality", and this thesis argues that these fictional worlds without relying on metafiction. To overcome these limits, texts that feature nonclassical fictional worlds can be examined as examples of a special type of speculative fiction text. Speculative fiction theories can describe the semantics and aesthetics of these texts while respecting them as fictional enterprises instead of metafictional ones.

This chapter develops a theoretical framework for the treatment of nonclassical worlds by adapting two prominent speculative fiction theories to fictional worlds analysis: Darko Suvin's theory of novum and Tzvetan Todorov's theory of the fantastic. First, this chapter compares two prominent fictional worlds frameworks: Aristotle's dramatic categories from *Poetics* and the possible-worlds fiction theory. PW fiction theory is the dominant approach to fictional worlds in contemporary scholarship, and many adherents pose this approach as a rejection of Aristotelian principles (Doležel 6). Therefore, this chapter compares the two paradigms, and exposes a common foundation in modal logic. This same foundation instigates many of their incompatibilities with nonclassical fictional worlds. This chapter then demonstrates how speculative fiction theories offer an alternative to modal logical restrictiveness. Finally, it proposes useful categories of analysis for examining nonclassical fictional worlds: chronotope, plot, and character. This process builds the theoretical foundation that guides my study of fictional worlds that reflect nonclassical scientific theories.

Dominant Fictional Worlds Theories

Shakespeare's *Macbeth* opens with a stage direction calling for "*thunder and lightning*", inviting the reader to imagine a stormy sky. A spectator instead hears the shaking of sheet metal and sees flickering lights, but is nonetheless asked to imagine that the thunder and lightning is being caused by a storm in some imaginary elsewhere. If a witch mentions the weather, spectators and readers alike are aware that she hears thunder and feels rain. The weather is real to the witch. These dramatic conventions convince the reader to imagine that onstage events are actual events in another world: the fictional world of the drama. Fictional worlds are complex structures organizing every dramatic element from weather conditions and social customs to space and time. They are the illusion that the space on stage is some other world and that the actors are some people elsewhere. Describing how texts convince the reader to imagine a world is at the heart of fictional worlds theories.

Since Aristotle's *Poetics,* scholars have created frameworks to describe how texts create fictional worlds. *Poetics* never names fictional worlds as such, but nonetheless theorizes how a play creates the illusion of happening elsewhere. According to Aristotle, fictional worlds are created through an imitative act called mimesis: the performance imitates real people or archetypes that the spectator is familiar with (Aristotle 1448a.9–16). Many different definitions of mimesis (treated below) dominated scholarship about fiction until the 1960s, when many fiction scholars began embracing the possible worlds theory of fiction instead (Doležel 10). Whereas mimesis is built on the idea that there is only one world, the one in which we live, and all dramatic content must imitate it, PW fiction theorists turn towards logical semantics to talk about worlds that could be. Before examining this distinction in detail, however, it is important to highlight their shared foundation: both

theories pull their primary categories from modal logic. This reliance instigates both theories' incompatibility with the irregularity and uncertainty of nonclassical worlds.

Aristotle argues that a play can only create a fictional world if the events and characters seem "necessary or probable" (Aristotle 1452a.11)**.** PW fiction theory similarly requires a text to stipulate rules that govern what is possible, impossible, and necessary within its world (Doležel 12–24). These stipulations stem from modal logic, an extension of classical logic that deals with qualifiers. Classical logic is the logic of true or false: it concerns the twofold distinction between what "is" and what "is not". Classical claims have easily deduced truth values, found by ensuring everything that the statement claims "is" is, and vice versa. Modal logic concerns a more nuanced fourfold distinction between four cases:

case a) what is, and must be

case b) what is, and could have not been

case c) what is not, but could have been

case d) what is not, and could not have been

These cases in turn generate modal logic's four categories of being: what is necessary (cases a), what is actual (cases a and b), what is possible (cases a, b & c), and what is contingent (cases b & c) (Burgess 38). If something does not fit one of these four categories, it is impossible. Consider flipping a coin that lands on heads: heads is a possible result and the actual result, and tails is a possible result and not an actual result. Heads and tails are contingent, meaning they are mutually dependent and exclusive outcomes: because heads is "what is", tails necessarily is "what is not".

Modal logic is an invaluable reasoning tool, but also seems incompatible with nonclassical scientific ideas. For example, the uncertainty principle states that knowing a

particle's precise position causes that same particle to have an imprecise array of possible trajectories. A precisely located particle simultaneously has a 45° and a 100° trajectory despite these two properties being exclusive contingent results. Quantum uncertainty is similar to a single coin landing on heads and tails at the same time. This state is often illustrated with Schrödinger's cat, which is both alive and dead because of this quantum sporadicity[1]. The cat cannot exist in a logical sense because "alive" and "dead" are two contingent and mutually exclusive outcomes. Nonetheless, according to quantum mechanics this indeterminate cat does, at the nanoscopic scale, exist in both states simultaneously. Modal logic abhors contradictions, and so quantum uncertainty is logically impossible: any text that describes such a world cancels its own world-making project. This basic stipulation can be traced through Aristotle and PW fiction theory alike, and both approaches adapt modal logic into textual analysis.

1. Aristotle's approach to fictional worlds

In *Poetics*, Aristotle emphasizes the importance of "probability and necessity": he maintains that characters, objects, and events create a fictional world if they are "possible in accordance with probability or necessity" (1451a.39–1451b1). However, Aristotle never clarifies his understanding of these modal terms in relation to drama, and scholars have scrutinized them without consensus since Lessing's *Hamburgische Dramaturgie*. To appreciate how modal possibility traces through Aristotle's *Poetics*—and subsequently why his fictional worlds cannot be nonclassical—definitions of "probability and necessity" must

[1]"A cat is penned up in a steel chamber, along with the following device . . .: in a Geiger counter, there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer that shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat . . . mixed or smeared out in equal parts." (Schrödinger 157)

be established. In his article "Aristotle on Dramatic Probability", Neil O'Sullivan argues that two interpretations dominate contemporary discourse: *objective dramatic probability* and *subjective dramatic probabilit*y. Both interpretations describe dramatic probability as incompatible with nonclassical worlds.

The objective interpretation states that dramatic probability is "defined in terms of observable fact" (Goebel 42): to be dramatically probable is to be possible and likely in the spectator's everyday observable world. *Poetics* offers significant support to this interpretation: for example, Aristotle suggests that well-made tragedies depict historical persons because "…we do not believe that what has never happened is possible, but things which have happened are obviously possible…" (1451b.15–18). If dramatic content must be possible in the spectator's everyday observable world for the world-creating enterprise, then fictional worlds are fickle because different people believe different things are possible in the real world. *Macbeth*'s original audience was more inclined to accept witches as a possible observable fact than a contemporary audience would be. According to objective probability, audience members that believe in witches can imagine *Macbeth*'s fictional world, but those who do not believe in witches cannot imagine it. This definition suggests that *Macbeth* was a world-building text in its original context, but no longer is. This same disparity complicates the idea of placing nonclassical scientific concepts on stage: quantum mechanics and chaos theory both describe phenomena that happen outside of the scope of observable fact. If dramatic content must be objectively probable, then nonclassical speculative worlds may be unimaginable: no spectator can consider dramatic action inspired by quantum mechanics to be possible according to real world observables.

The subjective interpretation of dramatic probability alternatively understands "probability and necessity" as contextual pragmatic traits: instead of defaulting to real-world

limitations, a play establishes clear rules outlining what is possible within it. O'Sullivan argues that Aristotle's theory of dramatic probability implies contextual "plausibility" instead of objective probability: the initial state of affairs—the play's crucial first scenes—establish what is possible within the play's world and the action must arrive coherently therefrom (50–52). *Poetics* supports this interpretation as well: Aristotle asserts that "impossible incidents that are probable should be preferred to possible ones that are unbelievable" (1460a.28–29). By decoupling "believability" and "possibility", he implies that drama can lead the spectator into accepting dramatic action that is impossible in the everyday world as long as believable rules govern what is possible within the play's context. In *Macbeth*, the witches and their magic are introduced in Scene 1, and so the play establishes magic as possible in *Macbeth*'s world. However, despite increased flexibility, this interpretation still adheres to the troublesome modal restrictions: the text must establish what is possible, while exclusive contingencies are still impossible by definition. If a coin lands on heads it still necessarily did not land tails, and a quantum object with an imprecise trajectory is still not dramatically probable. Thus, even when interpreting "probability and necessity" liberally, the requirement seems at odds with nonclassical states.

The dramatically possible action must be relayed to the spectator, and Aristotle's theory of mimesis describes how the spectator witnesses the fictional world of a play. In *Poetics,* Aristotle argues that the spectator pieces together a play's relationships as "they observe and infer what each thing is e.g. that this person represents that one" (1448a.9–16). Mimesis is the process that allows spectators to connect actors to characters and characters to fictional persons; subsequently, mimesis seems incompatible with nonclassical fictional worlds. Scholars have translated *mimesis* in myriad ways: "the act of resembling, of presenting the self . . . mimicry, *imitatio*, representation, and nonsensuous similarity"

(Gebauer and Wulf 1). Within the fictional worlds paradigm, Lubomír Doležel interprets mimesis as a theory of representation that claims that fictional entities are "imitations or representations of actually existing entities" (6). While Doležel's interpretation is not the only one, it helpfully frames mimesis as a fictional world mechanism. However, imitation presupposes that the thing exists elsewhere: what does *Macbeth* imitate? Like dramatic probability, there are two primary interpretations of mimesis as representation: *direct representation* and *universalist representation.*

Direct representation supposes that fictional characters are prototypes of real-world historical persons, and therefore characters are direct references. When Aristotle suggests that plays include historical figures, he highlights the dramaturgical value of direct representation in the world-constructing enterprise. Universalist representation, popularized by Erich Auerbach, is the prevailing interpretation of mimesis in contemporary scholarship (Doležel 7). According to universalist mimetics, the spectator interprets fictional characters as references to familiar universal types, which can be psychological, conditional, economic, and so on. Many fiction theorists, such as Doležel above, argue that universalist representation is a cyclical theory: the reader sorts actual world objects into abstract categories by creating universal archetypes, and then sort fictional characters into those same categories (8). The question of imitation is delayed and not answered because the universal types are the reader's own fictional abstractions—where do those abstractions exist? Nonclassical scientific ideas appear incompatible with both interpretations of mimesis. The spectator cannot see quantum uncertainty in their everyday world, and thus have no particular or universal category for it. Therefore, he or she cannot connect the representation to the thing represented, the nonclassical representation fails, and the world-creating project ends.

Regardless of how dramatic probability or mimesis are interpreted, a final question lingers: how does Aristotle determine if a fictional world has been successfully created? Aristotle suggests that probability and mimesis facilitate believability, which in turn leads to catharsis. Put simply, catharsis is some emotional reaction to staged events. It is achieved by showcasing emotions that somehow affect those same emotions in the spectator: "accomplishing by means of pity and terror the catharsis of such emotions" (1449b.28–29). He goes on to say that dramatic events must work accordingly and depict "terrifying and pitiable incidents" (1452a.1–3). Aristotle seems to argue that dramatic possibility and mimesis are necessary because the spectator can only empathize, sympathize, or otherwise cathartically react to staged emotions if they are believable. While *Poetics* emphasizes the catharsis of pity and terror in tragedy, Aristotle clearly sees catharsis as the goal of all drama: in *Politics VIII*, he states that catharsis is the function of tragedy, epic, and comedy (1339b42–1340a27). Catharsis seems to indicate if a play successfully creates a fictional world: if the stage illusion is powerful enough to cause catharsis, the link between dramatic probability and mimesis is strong enough to create a fictional world.

When examining speculative fiction—or, indeed, most contemporary fiction—catharsis is troublesome: it is no longer a ubiquitous dramatic goal. Contemporary texts provoke intellectual, visceral, and/or emotional reactions that Aristotle would not deem cathartic. A text depicting nonclassical scientific incidents is especially difficult to describe in these terms. Aristotle is interested in plays whose causal structure deterministically leads the spectator towards recognizing emotions, and speculative fiction texts are instead driven by intellectual speculation (Introduction). As a tentative equivalent, the reader's recognition of the speculative element could be seen as intellectual catharsis i.e. accomplishing by means of speculation the spectator's own speculation about the same ideas. This equivalence,

however, seems dubious. Furthermore, Aristotle does not propose a theory of how the spectator recognizes, sorts, and experiences emotions. Catharsis' deterministic needs and focus on emotional response makes it unsuited for the study of nonclassical worlds in speculative dramatic texts.

Aristotle's fictional worlds thus appear incompatible with nonclassical science. Uncertainty and irregularity are not possible according to his laws because they allow contradictory information to co-exist. Uncertainty happens at a scale too small for the spectator to access and chaos is noticeable at a scale too large, making it difficult for either situation to be analysed in terms of mimetic relationships. Finally, speculative texts are not necessarily working towards catharsis. PW fiction theory abandons Aristotle's insistence on catharsis and mimesis to grapple with contemporary texts by turning towards alternative textual goals: reference and authentication.

2. Possible Worlds fiction theory

PW fiction theory furthers Aristotle's modal terms by borrowing contemporary formal semantics to describe fictional worlds as logical structures. A brief summary of the history of possible worlds semantics and fiction theory helps illuminate the paradigm's roots. In the late 1950s, logician Saul Kripke tapped into a long tradition of "possible worlds" rhetoric to design a formal semantics for modal logic[2] in his article "Semantical Analysis of Modal Logic I". Kripke's semantics is an interpretive model designed to analyze complex modal situations by treating every possible outcome as a different possible world. From this essential work, the possible worlds semantics approach to modal problem solving was born. David Lewis later extended Kripke's work to account for intuitively true counterfactual

[2] Possible worlds began in philosophy in the early 18th century, when Gottfried Leibniz introduced possible worlds (*les mondes possibles*) in *Théodicée* (1710) as a component of his metaphysical argument that god ensures we live in the best of all possible worlds (*le meilleur des mondes possibles*)

statements in *Counterfactuals*, such as 'had I not eaten that extra serving, I would not be as full'. Lewis' interests led to literary investigations in 1978's "Truth in Fiction" and subsequently instigated PW fiction theory[3].

Beyond Lewis, pioneering theorists include Umberto Eco, Thomas Pavel, and Lubomír Doležel. Pavel recognized that possible worlds semantics would allow scholars to distance their work from Aristotle's mimesis: it explained how a text can stipulate its own domain of reference, a possible world, instead of referencing the real world through mimesis (175). Eco then bridged possible worlds semantics and semiotics by treating literature as a "machine for producing possible worlds": the interplay of signs and pragmatic context generates a series of possible worlds ranging from the reader's temporary speculations, the author's intended world, the speculations of characters, and more (246). Doležel furthered this stance by framing literature as a speech act[4] that, given the right felicity conditions, is capable of "a world's creation or destruction" (146) by stipulating a fictional domain and then referencing that same domain. These theorists firmly grounded an approach to fiction that separated itself from Aristotle's mimesis and catharsis. However, they simultaneously further entrenched fictional worlds scholarship in modal logic categories.

PW fiction theory treats fictional worlds as interpretive semantic models. These worlds are comprised of many domains, and each domain is a complex array of modal stipulations that generates characters and stories. They are controlled by modal rules determining what is and is not possible within them, thus establishing what can and cannot

[3] Lewis' work relied on *modal Realism*, the idea that possible worlds actually exist and are not interpretive models. This concept is heavily criticized: Kripke does so harshly in *Identity and Necessity*, and Robert Stalnaker in "Possible Worlds". Subsequent PW fiction theorists have largely distanced from this metaphysical stance.

[4] Speech act theory, introduced by J.L. Austin in *How to Do Things with Words*, argues that statements do not need to describe a situation or state a fact, but can also act as a performative force. The act of constructing a fictional world is not true or false, nor is it descriptive, but rather it is a world-constructing activity (Rabinowitz 557-558)

exist. Doležel identifies four primary modal categories that structure domains: alethic (what is possible), deontic (what is allowed), axiological (what is good), and epistemic (what is known) (114). When a text fails to indicate its modal constraints, readers assume the fictional world follows the everyday world's modalities. Lewis first stipulated this condition in "Truth in Fiction", asserting that (1) fictional worlds are modeled after the real world, and readers subsequently evaluate fiction in relation to the real world, and (2) fictional texts can diverge from the actual world as long as the reader can parse the divergence and understand the fictional world's laws (37–46). These principles echo the two interpretations of Aristotle's dramatic probability. Lewis' concept has been variously morphed into "the principle of minimal departure" by Marie-Laure Ryan (48) and "the reality principle" by Walton Kendall (144).

When everyday modalities are violated, as in speculative fiction, the reader separates the violating party into a non-everyday domain. For example, *Macbeth*'s witches belong to a supernatural domain wherein magic is possible as an alethic rule. There is an alethic divide between humans and witches: prophecy is possible for witches, but not for humans. Thus, texts construct domains by insinuating that constituents submit to different groupings of rules, and the reader reconstructs domains by observing these divides. However, the same limitations pervading Aristotle's dramatic probability rear up again: this structure stipulates that domains cannot exhibit contradictions. Something cannot simultaneously exhibit "case (a) what is and could not have been" and "case (b) what is not and could have been". Like Aristotle, PW fiction theory cannot accept a quantum object, which has a precise location and an uncertain array of contingent, contradictory trajectories.

After this shared reliance on modal logic, however, the two approaches diverge greatly. Where Aristotle understands fiction as a system of rearranging and imitating real

world prototypes (mimesis) that leads to an emotional reaction, PW fiction theory understands fiction as a system of stipulated reference that leads to interpretation or understanding (Doležel 24). This idea stems from Roman Jakobson's communication model, which describes communication as a bi-directional meaning-making activity. The sender constructs a message with an intended meaning and the receiver reconstructs that meaning through familiarity with the language and its context. In dramatic texts, the dramatist (sender) constructs the play (message) so it references fictional situations (meaning); the reader (receiver) then mentally reconstructs the referenced fictional situations (meaning) through familiarity with the context (dramatic conventions) (Jakobson 353).Thus, when a text constructs a fictional world, it establishes an internal referential context that allows the reader to interpret dramatic content as a reference to fictional situations.

While PW fiction theorists agree that the text references fictional situations, they do not agree about the nature of missing or incomplete information. *Macbeth* never tells the reader what colour Macbeth's hair is: so what colour is it? Doležel argues that fictional worlds are radically incomplete, and all non-stated information is not a part of the fictional world (22). The fictional world thus exists nowhere outside of the negotiation between the text and the reader: the text's speech act calls the world into existence, and the reader imagines that world through reconstruction. According to Doležel's theory, Macbeth lacks hair colour because the text describes none: he is a stipulated, amorphous set of properties that can be referenced. Ryan and Kendall disagree, arguing that a fictional world contains multitudinous possibilities: the reader's imagination is a functional part of the fictional world. Ryan and Kendall would put forth that there is a possible Macbeth for every imaginable hair colour, echoing Eco's idea that literature is a machine that creates possible worlds.

Finally, fictional reference introduces a new issue integral to understanding speculative fiction: how does the reader know what information is a part of the system of references and what information is metaphoric, poetic, or otherwise not a part of the fictional world? Doležel's theory of authentication offers a solution, and authentication is arguably the most important element of PW fiction theory. Fictional worlds are not beamed into the reader's head, but are introduced by different textual discourses: in literature, the discourse of a narrator, and the discourse of characters through reports, dialogue, and internal thoughts. However, characters can lie, and narrators can offer similes and metaphors. A conventional force 'authenticates' the world by separating the domain of "fictional facts", the actual case of a fictional world, from the domain of "fictional virtuals", things introduced by characters (Doležel 49). Literary scholar Thomas Martin's theory of "semantic relativism" reflects authentication: convention prompts the reader to "read the texts of literature as if they were true" (Martin 117). Authentication fails—and a fictional world cannot exist—if the authenticator confirms contradictory information; if the narrator says that the result of a coin flip is heads and tails in different paragraphs, two exclusive contingent events violate each other, and the world is unimaginable. This process is called voiding by Doležel (165), and Ryan describes a similar situation as noncommitment (115). If the text authenticates information and eradicates contradictions, then the text stipulates a world and the fictional world is constructed.

Literature has long-established authentication conventions such as the third-person omniscient narrator; theatre's material conditions make authentication trickier. Kier Elam tackles the issue of authentication (without naming it) in *The Semiotics of Theatre and Drama*. Elam argues that "in the absence of narratorial guides . . . the dramatic world has to be specified from within by means of references made to it by the very individuals who

constitute it" and the spectator must "infer the make-up of the world by apparently witnessing it" (101). Where literature's narrators authenticate fictional facts, the dramatic reader must authenticate the world by observing action and reading stage directions. The onstage space, and the events that occur therein, possesses the narrator's authority. However, the basic authenticating process is unchanged: if onstage events show a single coin-flip result in "heads" and "tails", neither contingent possibility can be authenticated, and the world voids. The theory of authentication thus suggests that the primary discourse—the onstage action—cannot display contradictions. Quantum uncertainty onstage would be contradictory, and so PW fiction theory says the world voids and metafiction takes over. Authentication, relying on possibility and modal contingency, suggests that nonclassical worlds cannot be constructed.

In summary, Aristotle and PW fiction theory are both motivated by modal concerns. Aristotle believes that dramatic content must be possible to convince the reader that the staged events reference actual prototypes and subsequently move them towards emotional reaction. PW fiction theory alternatively proposes that dramatic content must construct an internal context for reference, and the text must therefore sort information into non-contradictory categories while an authenticating force verifies what information belongs to the fictional world. Both frameworks reach instability when confronted with nonclassical scientific concepts: uncertainty and irregularity cause modal contradictions that end the world-constructing enterprise. This thesis overcomes these limitations by turning towards two speculative fiction theories: Suvin's theory of the novum and Todorov's theory of the fantastic. These theories are designed to explain how the text encourages the reader to accept strange constituents. This thesis proposes that they can be borrowed to describe how a text references, authenticates, and ultimately constructs nonclassical scientific structures.

Speculative fiction theories as alternative authentication

By definition, a speculative text constructs a world that features some contrasting alternative to the everyday observable world. Some texts saturate the world with so many alternatives that it bears little resemblance to the real world—or, in extreme cases, none at all. Others methodically introduce few controlled alterations into an otherwise everyday-seeming world. Worlds that reflect nonclassical science can be loosely described as fantastic-uncanny according to Todorov's typology (Introduction): a human discovery changes the traditional everyday world, expanding the domain of possibility. However, nonclassical worlds accomplish this expansion through the negation of the domain's supremacy: instead of making some new thing possible, they loosen possibility's grasp on the fictional world. Quantum uncertainty undermines possibility because contradictory possible outcomes are given equal actuality. Chaos undermines possibility because the necessary outcome is not necessarily the most probable-seeming outcome: the path between cause and effect is so convoluted that probability is rendered useless. Thus, these fictional worlds speculate about a change that makes them incompatible with the modal logical categories and authentication mechanisms defined by the previous approaches. How, then, could such a text lead the reader towards alternative routes of construction and authentication?

Speculative fiction theories offer an alternative authentication process that takes over when modal-possible authentication fails. First, the text integrates nonclassical science as a novum—a "strange newness" that elevates the theory to a perceptible level. Second, through a process of extrapolations, the text speculates on how that novum alters the otherwise everyday fictional world. Third, the fictional persons are interested in the novum, and their fictional investigation leads the reader through the nonclassical ideas required for the reader

to likewise discover the strange condition of the fictional world. This set of properties is the basic structure of a speculative drama that successfully constructs a nonclassical world.

1) The novum of the text. In *Metamorphoses of Science Fiction: On the Poetics and History of a Literary Genre,* Suvin offers a theory that accounts for the interaction between everyday and speculated elements in science fiction texts that he calls the *novum* (64). Suvin defines the novum as a "relationship deviating from the author's and implied reader's norm of reality"(64): it is a qualifiable (identifiable and recognizable) and quantifiable (in terms of magnitude of change) speculated alternative that changes what can happen in the text's world. For example, in *Harry Potter*, magic is the novum because it separates the world of *Harry Potter* from the everyday observable world. Suvin echoes McLean's arguments about speculative fiction (Introduction), positing that aesthetically interesting texts construct their novum methodically: there must be a recognizable "way, approach, atmosphere [and] sensibility" that generates the specific fictional elements indebted to the novum (67). Elsewise the text will not plausibly construct the relationship between the novum and the otherwise everyday world. To Suvin, the novum generates the unique aesthetic joy of speculative fiction—"the displacement and interpretation of reality by visiting an uncanny irreality" (67). In a nonclassical world, quantum theory or chaos theory is the text's novum. The "implied reader's norm of reality" is the laws of the Newtonian everyday world; a nonclassical novum elevates nonclassical scientific theories to the level of perceptibility for the reader and potentially the characters. All textual elements that reflect the theory are connected to the novum, and, therefore, the reader must authenticate the novum to reconstruct the fictional world.

2) The interaction and authentication of the novum and the everyday. Suvin does not work in the fictional worlds paradigm, but his novum translates easily into an alternative

theory of authentication. According to Suvin, when the reader confronts the novum he or she experiences "the presence and interaction of estrangement and cognition", a "semantic game" that lets the novum find fictional existence (5–8). Reflecting the principle of minimal departure, Suvin argues that readers furnish everyday objects (e.g. an apple) with information from the everyday world (e.g. the last apple the reader saw) (10). When the reader approaches a non-everyday object (a vampire in *Dracula*) the text urges him or her to examine this object "scientifically". As long as the text treats everyday objects convincingly, Suvin's reader considers how the real world would interact with the speculated object. If the reader agrees with the interaction between the speculated and everyday constituents displayed by the text, then the reader reconstructs the fictional world (65). This process is instigated by the novum—an underlying relationship between the strange objects that deviates from the reader's observable world. If the reader interprets contradictory information as related to the novum, and subsequently accepts how that contradiction could result from the novum, then the reader reconstructs the fictional world regardless of its impossibility. The reader is lead to accept dramatic content as fictionally factual despite it breaching the modal concerns of Aristotle and PW fiction theory. Suvin's theory of novum describes how the text convinces the reader to reconstruct a fictional world that undermines modal categories—quantum worlds where impossible activity can spontaneously happen and chaotic worlds where cause and effect are uncoupled.

3) The reactions and investigations of the characters. Suvin approaches his theory from the reader's perspective and frames speculative fiction as a cognitive genre; Todorov echoes similar sentiments while focusing explicitly on the text. Todorov's fantastic narratives convince readers that they happen in "a world of living persons" by constructing three-dimension characters that react to strange objects the way the reader might (*Fantastic*

23–24). To Todorov, characters within the fantastic genres must therefore act as fictional people. Todorov, therefore, understands the principle of minimal departure as a textual mechanism instead of a reader response. The text asserts that everyday laws govern the everyday constituents, and these everyday constituents must find the speculation as strange as the reader. The everyday objects are authenticated through regular means because they follow everyday rules, and their reaction to the strangeness is also authenticated because they react as everyday beings might, convincing the reader to follow suit and treat the speculation as a fictionally authenticated strangeness. In Jakobson's terms, Suvin's description of science fiction discusses reconstructive mechanisms and Todorov's theory discusses constructive ones: Todorov's texts cultivate a subjective context that authenticates strange objects by maintaining an everyday world around them, and readers then recognize that speculated objects are controlled by a novum through Suvin's semantic game. Fictional persons react to strange objects as the reader might, and are, therefore, likely to investigate such objects: when a character discovers more about the novum, the reader is urged to follow suit. This interplay illuminates another common speculative fiction element: the prevalence of detective narratives.

Detective plots are common in speculative fiction precisely because they facilitate the interaction between the everyday elements and the speculated ones. Simply put, in the detective story a detective character must uncover clues to make sense of an unsolved crime. The relationship between detective and speculative fiction has not been formally addressed, but Todorov's typology of detective fiction integrates into Suvin's theory of the novum. In *Poetics of Prose*, Todorov argues that the detective narrative is about the interplay of two stories: "the story of the crime and the story of the investigation" (44). The first story is a tantalizing mystery that ends before the plot begins, while the second story is "a slow

apprenticeship […wherein] we examine clue after clue, lead after lead" trying to recover the first story's events (45). In the speculative text, the "first story" is the story of the novum—the strange alteration made to the world that the reader wants to recover—while the "second story" is the reader and characters' investigation into the novum's nature. Consider *Dracula*, which follows several investigators trying to decipher disparate clues and discover the true nature of the titular monster. The "first story" is the hidden history of vampires, a mysterious and exciting story the reader will never see; the reader instead sees the second story, and enters the slow apprenticeship to piece together the history of vampires just as the characters do. As Suvin mentioned above, the speculative text must laboriously describe its fictional world to prove that strange objects grow from the novum: the detective fiction plot makes this process of "scientific" unveiling easier because the characters are investigating the same aspect of the fictional world.

Thus, nonclassical fictional world construction can be described by tracing how the novum alters an otherwise everyday world, and then examining how the text leads the reader through a "slow apprenticeship" to understand how the modal constraints have been replaced. In subsequent chapters, the analysis of the chosen plays demonstrates how these plays place characters into an investigative plot that either mirrors or directly references quantum mechanics or chaos theory. The investigation of the characters reveals quantum or chaotic ideas as a "relationship deviating from the author's and implied reader's norm of reality" (Suvin 64): a quantum mechanics or chaos theory novum. Through these speculative fiction mechanisms, these texts construct fictional worlds with nonclassical domains of reference that accept uncertainty and chaos. Tracing how the novum replaces everyday expectations, this thesis limits its analysis to three aspects of the dramatic text that are involved in world-constructing activities: space and time (understood as chronotope), plot,

and character. Chronotope, the category that best reflects nonclassical science, is the key feature of the nonclassical fictional world; often, plot and character help unveil the chronotope's unique non-everyday relationships.

1. Chronotope

Space and time, drama's most evident characteristics (Pfister 246), are the fictional world features most reflective of nonclassical science. Quantum and chaos theories alike emphasize irregular spatiotemporality: quantum mechanics is about uncertain space at small scales, and chaos theory is about irregular time at large scales. This thesis understands space and time through Bakhtin's chronotope, a theory of space and time in literature that claims there is a:

> . . . intrinsic connectedness of temporal and spatial relationships that are artistically expressed in literature. This term is employed in mathematics, and was introduced as part of Einstein's Theory of Relativity . . . in the literary artistic chronotope, spatial and temporal indicators are fused into one carefully thought-out, concrete whole. (84).

The chronotope is an analytical unit that represents the frequency, ratio, and clarity of spatial and temporal markers distributed throughout a narrative text. Bakhtin borrows Einstein's terms, recognizing the metaphorical richness of his conception of time: this thesis extends Bakhtin's work to consider post-Relativity scientific conceptions of space and time. Chronotope analysis requires a clear definition of fictional space and fictional time for drama, which this thesis primarily borrows from Karel Brušák and Manfred Pfister.

Some scholars argue that space is drama's ultimate category: Michael Issacharoff argues that a play "must take place somewhere" even if all other conventions go unmet (211). In contemporary scholarship, theatrical space is often divided into three categories:

theatre space (the building's architecture), stage space (the stage and scenery), and dramatic space (the fictional locations) (212). Recently, scholarship has become increasingly interested in the theatre space and the city surrounding the venue, examining how architecture and urban space influence theatre's semiotic exchange (Carlson 41–54). This thesis, however, focuses on the dramatic text, and so it emphasizes dramatic space, which Issacharoff defines as "space as a semiotic system" (214): the references, signs, and mechanisms constructed by the dramatist to establish the locations of the play, as well as the relationship between location and other dramatic elements. In this thesis, dramatic space is analyzed through the theories of Karel Brušák because Brušák's categories of space fit clearly within the possible worlds paradigm.

Brušák identifies two types of dramatic space: action space and imaginary action space. Action space is the dramatic space created onstage through the action witnessed by the readers, and imaginary action space is implied by the reports of characters or offstage sounds, and is only constructed in the reader's imagination (146–147). Issacharoff, who makes a similar but not identical distinction between "mimetic" and "diegetic" space, argues that "dramatic tension is often contingent on the antinomy between" what is shown on stage directly and what is not (211). According to Brušák, the action space convinces the reader that they have just witnessed "a unique and unrepeatable reality" (145). In fictional worlds terms, the action space takes over the authenticating power of a literary text's narrator and is the most accessible window into the fictional world—something implied by Elam above. While the action space has conventional authenticating power, imaginary action spaces are more conducive to dramatic effect because they move space into a more flexible medium, language (Brušák 155–156; Issacharoff 212). A murder described as horrific is horrific,

while an onstage murder that prompts laughter does not read as felicitous and, therefore, voids the world.

Brušák's terms highlight that the interplay of imagined and onstage spaces is integral to understanding speculative drama's novum: constituents in the action space or scenery either successfully authenticate into the domain of fictional facts or void like the unintentionally humorous murder scene. Similarly, the imaginative space allows the novum's semantic game to proceed with greater flexibility, but it also risks being relegated to the domain of unconfirmed virtuals. The distribution of fictional locales through the action space is also integral to the chronotope: if the action space fixes on a singular location, that location "takes on flesh" because it is constantly being "described" by the scenery and set (Bakhtin 84). Action space that features continuously changing locations is disorienting and nonclassical.

My analysis of dramatic time relies on Pfister's temporal categories: the fictional time-scale of the play and the real time-scale of the performance (275). Conventionally, the fictional time-scale and the real time-scale move in the same direction—every scene happens after the last in both the plot and the story—but the fictional time scale gets compressed (between scenes), elongated (at moments of timelessness such as soliloquies) or elsewise jumps (episodes) (Pfister 279–281). The discrepancy between the actual-time and fictional time generates many dramatic conventions: action space conventionally features fictional time in a 1:1 ratio with actual-time, and temporal compression instigates new scenes and blackouts. The tempo of scenes, the (ir)regularity of the text's temporal trajectory (i.e. direction of fictional time), and the uniformity of temporal markers (clocks, characters mentioning the time, etc.) all indicate the text's chronotope. A text's novum can generate nonclassical deviations from these conventions: for example *Arcadia* employs an irregular

flow of time that oscillates between two time periods that advance at greatly different temporal rates.

Finally, conceptualizing the chronotope of a play requires comparing the reader's spatiotemporal awareness with that of the fictional persons. Nonclassical science indicates strange spatiotemporal relationships that can only be noticed at an elevated level of spatiotemporal awareness. Similarly, the text can give the reader a superior spatial (*Possible Worlds*) or temporal (*Arcadia)* vantage point, allowing him or her to recognize nonclassical activity that the fictional persons cannot perceive. The reader's level of awareness shapes the chronotope in every case study: *Possible Worlds*' and *Arcadia*'s superior awareness interrogates the ramifications of nonclassical theories, and *Homebody/Kabul*'s congruent awareness emphasizes uncertainty.

2. Plot

In this thesis, plot is mostly understood as an indication of fictional time and causality. I approach plot through Pfister's well-known categories of analysis: the segmentation of scenes (number, length, ordering), the devices that link scenes to one another in a causal (or acausal) relationship, and the plot's open or closed nature (211–242). Each of these categories can reflect nonclassical scientific principles: for example, atemporal ordering is suggestive of chaos' irregular time. Pfister's principle of succession, which states that "within the continuous time-space framework of a scene the presentation strictly follows the order of actions and events as they occur in the story . . . this principle also controls the sequence of scenes…" (201), is particularly important. This principle is deterministic (i.e. scenes cause one another) and linear (i.e. scenes move from beginning to end) and incompatible with nonclassical theories—when the principle of succession is broken, the

novum is at play. Whenever the dramatic text breaks any of the above conventions, I examine how the nonclassical novum necessitates that irregular composition.

3. Character as fictional person

Todorov posits that character is the foremost category in a speculative text's world-constructing endeavour. Characters' reactions to the novum convince the reader to reconstruct the text as a "world of living persons" instead of allegory or metaphor (*Fantastic* 33). For this reason, characters are treated as fictional persons that are constructed in adherence to the novum's principles. In fictional worlds analysis, characters are understood as fictional persons (beings) that are stipulated to exist within the fictional world being studied. This approach understands characters as semantic objects that are "modeled as an individual who is a member of some non-actual state of affairs" and indicated by a referring expression such as a character name, description, or, on stage, a body (Margolin 53).While this approach involves examining a character's human-like aspects, these aspects are understood as properties of the character assigned by the text so that character can fulfill a narrative or aesthetic function.

Uri Margolin posits that this conception of character has three notable properties: (1) a character has some unique trait (individuality) that is consistent amongst the many states it occupies over the course of the narrative, (2) whenever a character enters a new state it exhibits at least one unique property to that state, and (3) a character features a "coherence of features, which means that they form a definable pattern or intelligible structure" including temporal continuity (53). Fictional persons should have some consistent properties, some properties that change depending on their state, and they should follow a pattern by not self-contradicting. This thesis must understand character's as fictional persons to fulfil Todorov's theory of how speculative worlds are introduced to the reader: the reader must accept

characters as stipulated persons to accept that characters react to strange objects the way a real person might.

Aristotle and PW fiction theory both hold possibility as the supreme world-constructing mechanism: the text must convince the reader that something is possible for them to place it in a world. However, nonclassical science has abutted against the very idea of possibility. Things that are intuitively, or at least observably, impossible nonetheless appear to be actual at very small and very large scales. Some contemporary dramatists have moved these 20th century nonclassical scientific ideas into the range of perception—for reader and character alike—by constructing speculative worlds that operate under strange new rules. Because the previous frameworks rely on possibility as a concept, they struggle to describe how a nonclassical world is constructed. The following chapter tests the theoretical approaches described above against Mighton's *Possible Worlds.* First, it examines the play's world through Aristotle's and Doležel's approaches, and then it demonstrates the value of the speculative theories developed in this chapter. By considering *Possible Worlds* as an example of speculative fiction drama that integrates quantum mechanics into its structure, one can explore the unique aesthetic experience and semantic games that allow a modally 'impossible' world to be referenced as a fictional one.

Chapter 2: *Possible Worlds,* Fictional Worlds Theories, and the Many-Worlds Interpretation

No interpretation of quantum mechanics intrigues the imagination quite as much as the many-worlds interpretation. According to this interpretation, whenever a particle faces multiple possibilities—whenever it is uncertain—every possibility is actual in at least one of near-infinite actual worlds. Hugh Everett introduced the idea to physicists in 1957, and in the intervening half-century Everett's ideas have been made accessible to laypeople by popular science educators such as Stephen Hawkings. Contemporary dramatists can dramatically interrogate the fertile grounds of many-worlds theories, comparing different theories and examining their everyday-life implications. John Mighton's 1990 play *Possible Worlds* weighs two different many-worlds frameworks against one another. It alternates between suggesting that there is a single world wherein people imagine 'possible worlds' that are nothing more than cognitive illusions, and a plurality of worlds wherein every possibility is actualized. This chapter hypothesizes that John Mighton's *Possible Worlds,* when understood as an example of speculative fiction, constructs a speculative world wherein the modal constraints of possibility are replaced with a pluralized fictional actuality.

The following chapter has several goals. First, it conducts an analysis of *Possible Worlds* according to prevailing fictional worlds theories, looking at Aristotle's Poetics and PW fiction theory as its theoretical lens. By speculating about the many-worlds interpretation of quantum mechanics, *Possible Worlds* constructs a world wherein possibilities are all equal actualities: this construction contradicts both prevailing frameworks (Chapter 1). Using PW fiction theory, this chapter proposes two readings of *Possible Worlds*: (1 the play's nonclassical elements are falsehoods from the discourse of a character's imagination and are thus not part of the world's structure, and/or (2) the play primarily functions as metafiction

and is not a world-constructional text. This first section clearly demonstrates the specific difficulties the PW fiction theory approach meets when facing a nonclassical world.

After addressing the successes and failures of the readings generated through the PW fiction theory approach, this chapter turns to the many-worlds interpretation of quantum mechanics and suggests that *Possible Worlds* can be read as speculative drama that constructs a nonclassical fictional world with the many-worlds interpretation of quantum mechanics as its novum. In her examination of *Possible Worlds*, Elizabeth Klaver quips that the play sounds "like something out of science fiction fantasy or theoretical physics" (45). This chapter endeavours to treat *Possible Worlds* as just those things. The play's dramaturgy is reminiscent of Heisenberg's uncertainty principle: it fixes time in an absolute flow to examine the nonclassical space created by the many-worlds novum. This chapter therefore examines the fictional world of *Possible Worlds* in detail to demonstrate the value of speculative fiction theories when examining nonclassical worlds; this in turn offers insight into how dramatists interpret and utilize quantum mechanical ideas in their dramaturgy.

John Mighton

More than a playwright, John Mighton is a prominent math education figure in Canada. He is best known for founding the Junior Undiscovered Math Prodigies (JUMP) program, which "hope[s] to dispel the myths that currently prevail" about mathematics being too difficult for some children by developing childhood numeracy programs ("Mission"). Alongside his doctorate in mathematics from University of Toronto, where he also lectures in the math department, Mighton's background includes an M.A. in Philosophy from McMasters University. He is no stranger to considering how mathematical and scientific theories can be interpreted, how such interpretations challenge dominant presumptions about

reality. This interest in mathematics, philosophy, and art has led Mighton to a diverse career as an educator, researcher of knot and graph theory, film script advisor (for the academy award winning film *Good Will Hunting*), and, of course, dramatist.

Mighton advocates passionately for increased dialogue between artists and scientists; in his JUMP biography he states that "scientists and mathematicians are often led by a sense of beauty or elegance, and describe their work in artistic terms . . . if the two worlds communicated more, we'd have much richer art and science as a result" ("John Mighton"). His theatrical output reflects his multi-disciplinary concerns: since his earlier plays 1988's *Scientific Americans* and 1989's *A Short History of Night*, Mighton has staged scientific discoveries, figures, and ideas. He transforms complex theories into dramatic texts without losing conceptual complexity or over relying on cumbersome exposition. His work reflects science's "sense of beauty or elegance" mentioned above, and he mixes the intellectual joy of scientific learning and discovery with the aesthetic joy of theatre. This approach has been highly lauded, including a 1992 Governor General's Literary Award for Drama for *Possible Worlds.*

Possible Worlds

Possible Worlds, whose 1990 premiere was directed by Peter Hinton for the Canadian Stage company in Toronto, mixes Mighton's intellectual and aesthetic interests into a science fiction detective story. The play, best described as a "murder mystery with a metaphysical twist" (Stephenson 74), opens to a horrifying homicide crime scene, wherein a brilliant stockbroker, George Barker, has been murdered, and his brain stolen. Two detectives—Berkeley and Williams—investigate the crime and find more questions than answers. The odd case becomes supernatural when the pair uncovers irreconcilable clues: George's door

was locked from the inside, there are no signs of a break-in, and his brain was removed without leaving any abrasions. A rash of similar murders targeting the city's intellectual elite breaks out and the detectives conclude that the murderer has unimaginable superpowers; the murder can "see" possibilities outside most people's limited cognitive range, and mankind are like rats to this super-villain scientist (Mighton 60–61). Plentiful popular science fiction tropes emerge during the investigation: the text directly or indirectly features mad scientists (25), Frankenstein-esque brain-in-jars (26), aliens, secret Nazi programs, and genetic engineering (48). The detectives, resigned to defeat, solve the case by happy accident: when returning a putrefying brain-in-a-jar to Dr. Penfield, the mad scientist, he has the stolen human brains in plain sight.

If the plot focused solely on the detective story, the construction of its fictional world would be simple to describe. However, over half of the plot follows the murder victim, George, and his wife, Joyce, meeting for the first time, again and again. Each new 'first' meeting contradicts the last: George is variously a risk analyst, or Joyce's fellow power broker, or a stranger assaulting her on a beach. These different versions are not presented sequentially: instead they are interspersed with scenes from the detective plot. Occasionally a single scene will feature multiple versions of George and Joyce in quick succession (Scene 9). George offers an explanation for this strange quandary: everyone "exists in an infinite number of possible worlds" (23) and he is cognisant of each one. Some worlds are very similar to one another—"in one world . . . your arm is a little to the left, in another world you're interested in that man" (23)—and others feature strange monsters and failed medical experiments (41). George's explanation is more frustrating than helpful: the play refuses to confirm it, and readers are left asking why would these worlds share a single consistent George? Or, if George is lying and there is only one world, why are the other characters so

inconsistent between scenes? Mighton encourages readers to undergo their own investigative journey, consider theories about alternate worlds theories, and come to a conclusion about their everyday reality (Klaver 59–60; Stephenson 74).

As mentioned above, the last scene in the detective plot (Scene 17) solves the murder: Penfield murdered George and his dislocated brain now powers a cognitive science experiment. The play suggests that the infinite possible worlds were cognitive illusions generated by this experiment. George, lamenting that he is "in a case" (67), recognizes this fate in his penultimate scene, and he looks back as his many-worlds puzzle as a cognitive prison. One of Todorov's detective fiction tropes surfaces: the detective consolidates previously disparate clues, and the reader is asked to follow suit (*Prose* 47). However, while the characters are satisfied by this brain-in-a-jar explanation, the reader should not be because it fails to answer any of the questions raised by the investigation. It does not account for the killer's ability to walk through walls, remove brains without abrasions, or freeze people to death at room temperature. Therefore, a question arises: why does the 'actual world' of the play, the detective's world, contain supernatural activity if the supernatural is George's cognitive illusion?

The following section tries to describe how *Possible Worlds'* fictional world permits supernatural incursions through Aristotle's dramatic categories and PW fiction theory. This section demonstrates how a nonclassical fictional world—*Possible Worlds* and its array of contradictory possibilities—cannot be adequately described in the modal terms adopted by the prevailing frameworks. Afterwards, the chapter treats *Possible Worlds* through the speculative fiction lens proposed in Chapter 1 to demonstrate how speculative theories overcome modal limitations.

Possible Worlds' **Fictional World According to Prevailing Approaches**

1. According to the categories of fiction established in Aristotle's Poetics

Possible Worlds is difficult to describe as an Aristotelian dramatic world—dramatic probability appears unmet, mimesis is problematized, and catharsis is not offered (Chapter 1). The first incompatibility arises from *Possible Worlds*' acausal scene structure. In Scene 1 the detectives find George's corpse, in Scene 2 George and Joyce meet for the first time, in Scene 3 George applies for a new job and in Scene 4 George and Joyce meet for the first time again under entirely different conditions. The events in Scene 1 do not cause Scene 2's action (or Scene 3, etc.): the detective work does not cause George to meet Joyce, and causality is fundamentally disrupted. With a more liberal definition of causality, Scene 1 can be understood as *in media res*[1], and Scene 2 is related to Scene 1 through temporal analepsis[2]: after establishing the murder, the play retreats to its antecedent events. This temporal ordering is complex, but the scenes can still be understood as causally related in the subjective sense (Chapter 1): there are conventions (*in media res* and flashbacks) that establish a contextual causal relationship. Scene 4 disturbs this new reading when George meets Joyce for the first time again. Scene 1 moves into Scene 2 through analepsis, continues causally into Scene 3, but is then shattered in Scene 4. In the everyday world, people can only meet for the first time once so the interaction is not objectively probable. Whereas analepsis lends Scenes 1 and 2 a sense of subjective probability, it too is baffled by Scene 4:

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[1] *In media res*: "… in medias res is a device used to begin the story at a crucial point in the middle" (De Jong 242)

[2] *Analepsis*: "….the retrospective evocation of an event . . . a jump in time along sequences of events" (Ireland 591)

the same event is shown in a different location and the characters have different properties. George's journey cannot be causally understood, and dramatic probability is nullified.

The mechanisms of mimesis are likewise disrupted because fictional persons feature inconsistent properties. Aristotle's spectator understands the actor as the imitation of a character, and the character as an imitation of a fictional person. These fictional persons are bound by the same laws of dramatic probability that rule over the action: fictional persons must be plausible people in the spectator's everyday world, or elsewise constructed by subjective rules clearly established by genre. George and Joyce are neither. A single character, George, 'represents' multiple fictional persons—George the risk analyst and George the stockbroker—who are distinct entities represented by the same designator. George breaks away from classically rigid designators (name and body), and this taxes mimesis greatly. Multiple Georges are also shown to share a single pool of memories, making it impossible to describe George in mimetic terms. This issue is particularly noticeable when George becomes confused about his current world, such as when he mistakes Joyce (the neuroscientist) for Joyce (the stockbroker) (Mighton 38). Mistaking Joyce for Joyce should not be possible because, in everyday terms, Joyce is Joyce. Names do not point to universal types or even particulars, and so the spectator cannot connect George to a fictional person or empathize with his changing condition: cathartic potential is lost, and the text fails to construct an Aristotelian fictional world.

2. According to PW fiction theory

PW fiction theory, like Aristotle's theory of dramatic probability, defines fictional construction through a process of managing possibility. However, instead of requiring mimesis and catharsis, PW fiction theory requires a discourse, empowered by convention, to sort fictional facts from fictional virtuals so the reader can decode the text as a reference to a

fictional world. *Possible Worlds* can construct a world despite the onslaught of contradictory information as long as all of that information is sorted into the domain of virtuals. When characters declare contradictory careers, birthplaces, or hobbies, the contradictions damage the characters' reliability not the world's reliability. Therefore, George and Joyce are unreliable, not contradictory. Similarly, the reader never witnesses the killer's superpowers: these powers can be interpreted as unreliable information introduced by the incompetent work done by the detectives. Ongoing discussions between the detective and his assistant hint at the characters' unreliability: their senses cannot be trusted because they are "limited by the structure of [their] brain" (60). The plot is peppered with evidence that the characters are unreliable: George and Williams read pseudoscientific articles from *The National Enquirer* (13), Penfield's and Joyce's description of cognitive processes are unflattering (26), a character sympathizes with Nazis (48), and multiple characters suspect aliens (48). Thus, the domain of persons is constrained by cognitive unreliability as an alethic trait (Doležel 114): all creatures within it are necessarily unreliable. Reading the play thusly relegates much of the play's action to the virtual domain. If the discourse of fictional persons is unreliable, then the only source for fictional facts is the on-stage action.

Even the action space's contradictions can be resolved by considering the action space another virtual domain, an approach that is simultaneously promising and unsatisfying. The action space features a continuous stream of contradictory information: the reader witnesses George and Joyce meeting for the first time at a university restaurant (13), a crowded bar (21) and a beach (63). George is aware of these contradictory meetings (39) and his capability to move between them (23–24). However, as proven above, the domain of persons is necessarily unreliable and therefore George's explanation must be taken lightly. When the detectives discover George's brain, the text indicates that a cognitive experiment

generated the contradictory events in the action space. Every scene that features a living George is not from the domain of fictional facts, but rather virtual spaces created by George's unreliable imagination. The text avoids exposing the structure of its fictional world until the final scenes, which force the reader to re-evaluate the fictional world constructed previously. George's multi-world is replaced with a set of imagined cognitive possibilities. The reader's detective work is solved by eliminating the question "how is this world constructed?" in favor of "it is not constructed".

Klaver, who adheres to the reading above, suggests that the entire play can be described by mathematical set theory's version of possible worlds wherein "sub-worlds", a term she borrows from Eco, are nested in the "first world" of fictional facts (60; Eco 246). In *Possible Worlds*' world of fictional facts (world F), George is a brain-in-a-jar, and the detectives are investigating his murder. Every contradictory version of George's life is a sub-world composed by George's imagination (sub-worlds S_1, S_2, S_3, S_4…S_N). According to Eco's theory, these sub-worlds may intersect or contradict as long as they are compiled entirely from entities that exist in world F. If every feature of sub-world S_N exists in world F (for example, stockbrokers and neurologists exist), sub-world S_N can be imagined from world F (246). Therefore, George can imagine every S_N without contradiction. Each sub-world is essentially a play-within-a-play. When the play verifies world F as the domain of fictional facts, all the imagined solutions are moved to the domain of prior speculations: the virtual land of 'what-ifs' introduced by the detective work before being dashed by better clues (Todorov, *Prose* 45–47).

This approach moves the contradictory information away from the domain of fictional facts and into the virtual space of George's imagination, but in doing so it ignores

the strangeness of world F. Several world F scenes show unnatural events in the action space: in Scene 1, the reader sees the top of George's "skull with some hair on it" (12), which lacks abrasions as if removed by magic; in Scene 12, the space is furnished with the janitor's corpse, who "froze to death" in a freezer despite the fact that "the freezer wasn't turned on" (53); Scene 12 is also set in a magically invaded apartment, verifying the previous police reports that stated the killer enters houses without unlocking the doors (32). These supernatural touches are curious because the play painstakingly furnishes world F as an everyday world: it references real newspapers (13), towns (14), and firms (18), appealing to Aristotle's assertion that the reader will believe in a fictional world if it contains historical things (1451b.15–18). Where the opening scene could have clearly established the supernatural features as part of the world, the text instead stipulates the first scene as a detective story and frames these supposed superpowers as a mystery to be solved. Contradictory textual processes appear to be at work: the stipulations of the plot and the furnishing of the world suggest that it is a natural world, and the superpowers will be resolved through detective work, while the early introduction of the supernatural, its continued presence, and its lack of resolution suggest it is a component of the world.

Stephenson offers a PW fiction theory solution to these new questions by appealing to the metatheatrical device of metonymy. Stephenson agrees with Klaver and considers world F (the detective plot) to be the dramatic text's fictional world; she then traces George's imagined scenes' causal links by highlighting metonymies—relationships between superficially dissimilar but contextually similar objects. For example, the vat that houses George's brain in World F (Mighton 68) contextually links to a bowl in one sub-world (55), and a beach in another (63) through linguistic and situational clues. Readers tracing these connections become detectives themselves, mimicking George's own search for ontological

meaning as he tries to solve his many-worlds crisis and the play's own detectives (Stephenson 80–83). Stephenson argues that this doubling fuels comprehension of the bizarreness of George's plight, and so his bizarreness becomes objectively possible to a reader who is also experiencing it (88). She thus frames metonymic compression as an authentication mechanism (Chapter 1): in experiencing bizarreness themselves, the reader can verify the same bizarreness in the play as possible.

This metonymy extends to explain the bizarre supernatural incursions in world F: just as sub-worlds S_N are contained within fictional world F, fictional world F is contained within the actual world of the spectators (92). The killer's superpowers come from the fact that he is the playwright, whose superior position in the set gives him control. World F must therefore answer "how did the writer possibly kill George?" instead of "how did the fictional killer possibly kill George?". The answer is simple: by writing it as such. Stephenson's reader is lead to awareness of the actual world as George is lead to awareness of his brain-in-a-jar conundrum (his actual world), and so the supernatural dissolves into metafictional experience. However, a fictional world that relies on metafictional activity has questionable fictional status: Stephenson even notes that her proposed authentication method undermines the mechanisms supported in the prevailing PW fiction theory (88). Her interpretation authenticates George's experience as a possible experience by voiding the fictional world containing it. Additionally, Stephenson's approach still does not explain how the text constructs its world during the first sixteen scenes, when the reader is misled into thinking George's imagined worlds are fictional facts. Until the brain-in-a-jar solution is exposed, the reader, like George, constructs a many-worlds fictional world.

Possible Worlds as Speculative Drama

Stephenson's PW approach concludes that *Possible Worlds* is metafictional because that paradigm requires the dramatic content to be possible in modal logical terms. Elsewise, it is not fictionally factual, and the text does not construct the interpretive model required to decipher the text as a reference to a fictional world. However, despite constant contradictions *Possible Worlds* intuitively seems to be a world-building text. Characters are described as psychological persons, plentiful references to the everyday world establish the space as its facsimile, and the primary action is a kitchen-sink drama detailing George and Joyce's many failed relationships. If any single sub-world were isolated, that text's constructional nature would be self-evident, so is it possible to simultaneously respect the play's fictionality and plurality? Klaver and Stephenson both mention speculative fiction or science fiction while analysing the play, but neither scholar treats the material according to science fiction nor speculative fiction approaches (Klaver 45; Stephenson 91). However, *Possible Worlds* fits happily within speculative fiction theories.

If *Possible Worlds* is understood as an example of speculative drama containing a novum, then the semantic game brought by the novum creates a domain of reference without hinging on modal constraints (Chapter 1). The play clearly establishes a novum—the "infinite possible worlds" concept—and generates alternate laws therefrom. The novum reflects the many-worlds interpretation of quantum mechanics, which holds every possible course of action as equally actual. The following section proposes the many-worlds interpretation, as a textual novum, eliminates the modal constraint of mutual contingency—i.e. non-contradiction. This novum introduces nonclassical relationships between objects, and speculative fiction theories help describe this strange world. The novum constructs a fictional world wherein there can be many Georges, each equally a member of the domain of fictional

facts because the novum allows contradiction. In demonstrating this, *Possible Worlds* works as an example of the nonclassical turn in dramatic fiction: it constructs a fictional world, but do so on terms that reflect a post-quantum mechanics understanding of reality. Investigating scientific interpretations of nonclassical ideas helps better illuminate aesthetic interpretations of the same concepts.

1. Many-worlds interpretation of quantum physics as novum

The many-worlds interpretation explains quantum uncertainty by suggesting that there is a near-infinite array of actual worlds. Appreciating how this theory functions as a textual novum requires a basic understanding of the interpretation and the uncertainty principle. Heisenberg's uncertainty principle asserts that there is a fundamental limit to the precision with which one can simultaneously measure complementary properties of quantum objects. For example, momentum and position are two complementary physical properties: if a scientist accurately measures a particle's momentum, simultaneous measurements of its position will be imprecise. This strange property grows from matter's wave-particle duality: as explained by science historian David Lindley, all matter exhibits properties of waves—which transfer energy and move diffusively—and particles—which have mass and are easily located (118–122). While many philosophical and metaphysical debates rose from these discoveries, mainstream interpretations of quantum mechanics agree that this contradictory duality is a fundamental feature of the universe.

Several common interpretations of this duality and the resulting uncertainty have become popular. The Copenhagen interpretation, backed by Bohr and Heisenberg, interprets matter's wave properties as a probabilistic feature: the wave is where matter could be. When one measures a quantum object, the uncertain wave of probability collapses and matter's particular properties come to the forefront: it sporadically actualizes into a fixed location, a

theory called "wave function collapse" (Griffiths 4). Wave function collapse is anti-deterministic: nothing causes the particle to 'appear' as it does, and it could have equally likely appeared elsewhere with a different trajectory within the same wave of probability (3–5). Einstein, ever a classicist, steadfastly resisted any theory that implies that the physical universe is non-deterministic, and instead maintained that the uncertainty principle was a failure of measurement apparatuses.

A third interpretation designed to consolidate the two beliefs is most reflective of George's crisis in *Possible Worlds:* the many-worlds interpretation. This interpretation, first outlined by Hugh Everett III in 1957 and named by Bryce DeWitt in 1973, reconciles the two interpretations by replacing Copenhagen's wave function collapse with a plurality of independent, inaccessible universes whose distribution is governed by a probabilistic wave. The wave properties of matter represents where a particle exists in other worlds, but in any given world it is in a single spot with fixed properties. When unmeasured, the universal waveform is in 'coherence', but the act of measurement causes the waveform to "decohere" into the individual possible worlds implied by the waveform. Thus, each individual world is deterministic, but the over-all structure of reality—containing every world—is pluralistic (DeWitt 38–44). Scientists can mathematically derive what these possibilities are, but the real world will only ever actualize one of them, pre-determined by unknown mechanisms.

George introduces his own many-worlds theory in Scene 4. This introduction happens after the reader has witnessed his proposed theory play out in the action space because the same scene marks the first explicit onstage contradiction. George tells Joyce ". . . in one world I'm talking to you right now but your arm is a little to the left . . . in another you stood me up two days ago" (23) and the reader can mentally add "and in another we met in a restaurant and you were a neurologist" to that inventory. George's theory matches the

experienced strangeness, and thus the reader can accept the strangeness as a speculative novum and judge the dramatic content accordingly (Suvin 65–68). As a novum, the many-worlds interpretation of quantum mechanics possesses several easily accessible features: it will contain a plurality of sub-worlds, related to one another by possibility, and each sub-world will feature a causality at the everyday scale. The overarching fictional world is the entire wave function, the set of all "possible worlds". No individual sub-world has hierarchal status over the others, and they can gain hypothetical knowledge of each other the same way actual scientists attain hypothetical knowledge of the quantum wave function: mathematics, logic and imagination.

Possible Worlds' characters, plot structure, and chronotope all reflect this many-worlds novum. The plot's excited scene changes create a sense of nonclassical sporadicity, and characters are utilized to anchor the reader into individual sub-worlds. Most importantly, Mighton fixes dramatic time so he can explore the nonclassical space generated by the text's novum. Possible worlds are physical spaces that cannot be traversed by motion, and definitively breach Newton's absolute space (Chapter 1). To recognize the fictional world's structure, the reader must necessarily be positioned to have greater spatiotemporal awareness than the fictional persons could ever access (Pfister 51). The fictional persons are predominantly locked into singular worlds, and the reader needs to see many worlds in order to understand the ontological situation.

2. Many-worlds interpretation constituents and chronotope

Possible Worlds' scene structure echoes the sporadicity of particles undergoing decoherence, emerging from the waveform without direct causality. This is to say that its many worlds emerge in no discernable pattern: new worlds are introduced in Scene 1, Scene 2, Scene 3 (or 4), Scene 9, Scene 15, and Scene 18, the final scene. Despite establishing the

pattern of a new world every scene for the first three scenes, this pattern is rejected; after five more scenes it seems like no new worlds will emerge, until Scene 9 when another is introduced. Short scenes, reminiscent of excited quantum jumps, reinforce the sensation that these worlds emerge non-deterministically. This pacing is spontaneous instead of predictable; it does not cycle through worlds, and while some appear in many scenes (the detective plot is in seven of the play's eighteen scenes), others, such as Scene 9's and Scene 18's worlds, appear only once. Some, e.g. the world containing neurologist Joyce, receive copious onstage time before petering out unresolved (Mighton 52), while others end decisively and violently after a mere few pages (42).

The worlds are also not different possible outcomes of a single event: instead of showing alternative paths through a modal expression, such as "George is/is not successful in flirting with Joyce", the worlds depict events distinguished by myriad differences. In Scene 6, the dramatic text announces its disinterest in examining multiple possibilities emerging from a single claim by opening with the stage direction "*JOYCE is reading in a crowded restaurant, as in Scene Two. GEORGE enters. It should seem, at first, as if their first meeting is being repeated"* (28) before exposing that Scene 6 is Scene 2's continuation, not a repetition. Some worlds feature irreconcilable differences—one scene features a woman "that look[s] like a chicken . . . her backside like a huge rose . . . giving off some sort of scent" (41)—proving that the worlds are not simply different ways George's life could have been. Instead, the worlds represent divergent paths stretching as far back as the origins of the universe, where different quantum states generated worlds that ultimately produced strange lifeforms. These collective complications construct the worlds as a set of clearly delineated and unrelated spaces: they are not generated to answer questions posed in other worlds, nor are they slaves to an emergent pattern.

Despite being disconnected from one another, every world moves through an absolute future-facing flow of time: a principle feature of *Possible Worlds* and the many-worlds interpretation alike. New worlds are generated sporadically at moments of uncertainty, but these moments arise in absolute time that moves from past through present towards the future. When George tells stockbroker Joyce "in another [world] you stood me up two days ago" (23), Mighton exposes that all worlds share a single temporal frame. The dramatic text is rife with such temporal fixing: for example, another world's Joyce "died several years ago" (30) or "three years ago" (40) in different scenes. When Scene 6 cheekily misleads the reader into thinking it is a repetition of Scene 2, Mighton further highlights *Possible Worlds'* temporal regularity. Scene 6 is furnished "as in Scene Two" (28) to goad the reader into suspecting that Scene 6 and Scene 2 are the same event in slightly different worlds; the dialogue then exposes that Scene 6 is Scene 2's direct causal sequel—it is the same George trying to flirt with the same Joyce again. If Scene 6 were indeed Scene 2 again in a different world, temporal ordering would be shattered; this mislead and quick recovery playfully reminds the reader of time's forward arrow.

Possible Worlds' individual worlds exhibit clear temporal ordering and appeal to the principle of causality. This structure keeps with the many-worlds interpretation: there are many worlds that decohere (separate) from the wave function, but any given world is deterministic. In Scene 6, George and Joyce talk about the time that has passed since Scene 2 and George reassesses his flirting tactics based on Scene 2's failures and successes. Scene 6 ends with the promise of a date, and Scene 9 picks up some time later and the two are in a relationship. Between these scenes, Joyce's characterization changes dynamically in a recognizable arc: she goes from coolly detached to guardedly interested to woman in love. Similarly, Scene 4's Joyce has a one-night stand with George, Scene 9 shows the morning

afterwards, and Scene 13 depicts their violent falling out. The detective work begins in Scene 1 and follows a trail of clues and murders until Scene 17: as Todorov suggests, each scene gathers clues until the crime is eventually solved at the final hour (*Prose* 45). Every few scenes, the detectives update the body count, marking time through the narrative arc and building suspense. Just as time moves forward, the events of each world follow a dramatically plausible cause and effect chain: this is especially apparent in the stockbroker world where Joyce responds to George's disaffection by having an affair (Mighton 58) and in the detective world where detective work leads to the case being closed (68–9).

The quick succession of scenes and fixed forward march of time creates the play's many-worlds chronotope. This chronotope highlights the unique aesthetic potential of the nonclassical textual novum: by introducing the reader to strange objects and then organizing those strange objects around an accessible set of relationships (the novum), Mighton creates a chronotope stretching across impossible spaces. The speculative fiction theories indicate just that: the many-worlds are a component of the chronotope, and therefore are a part of the fiction's spatial arrangement instead of a voiding activity interfering with the fiction process. The spatiotemporal distance between the reader and the characters makes this possible: the reader's sweeping awareness of these mutually inaccessible spaces lets them witness patterns that the fictional persons, locked into individual sub-worlds, can only daydream about. The reader thusly can comb through the different worlds seeking interrelations and metaphysical clues, while characters are trapped by the limits of their personal one-world frame.

As a clear demonstrative example of the chronotope, consider this question: what action space is created by George and Joyce's first meeting? What should be a simple spatial question is complicated by a strange new multiplicity: "a crowded university restaurant"

(13), "a crowded bar (21), and an empty beach (63) are all verified in the action space as 'truthful' answers. When focusing on an individual decohered world, Newtonian space retains meaning: in the Joyce the scientist's world, the pair first meets in a restaurant. The strangeness arrives from looking at the coherent fictional world. The bewildering rate of location transitions reinforces this effect: the scenes are very short, and no two consecutive scenes are set in the same location—Scene 1 is George's apartment, Scene 2 the restaurant, Scene 3 an office building, Scene 4 the bar, et cetera. The action space is uncertain because mutually accessible spaces—George's apartment and police headquarters, for example—are mixed sequentially with inaccessible ones. Because this uncertain space is also the reader's only instrument for measuring "fictional facts", it takes on the properties of the wave function: it represents every possible space from every possible world. A dramaturgical Heisenberg's uncertainty principle is at play: because time has been fixed as absolute (precise), space is uncertain (imprecise). The chronotope allows Mighton to explore the implications of uncertain space implied by the many-worlds interpretation through drama.

The nonclassical chronotope's spatial uncertainty becomes compounded by the tight interaction between action space and imaginary space throughout the play. This interaction prepares the reader to accept that any world that can be imagined exists somewhere within the fictional world. From the first scene, wherein Berkeley mentions that he is "running over some possibilities" (Mighton 12), the play emphasizes the importance of imagination. Characters use their imagination to construct imaginary spaces while their body stands in the action space. Scene 8 demonstrates this process when Jocelyn guides the reader through imagination-boosting exercises. She asks the reader to "picture the eyes of someone you love. / Feel their hand caressing your face. / See yourself lying in their arms. / Imagine a cold wind when it's raining" (37). Each of these prompts emerges in the action space as the play

progresses—Joyce mentions the ghostliness of George's hand on her face (45), the pair entwines on the beach (74), and the final scenes heavily feature the rain. Here, Mighton emphasizes the interchangeability between imaginary spaces created through the speech acts of onstage characters (Doležel 146) and the action space. George confirms this relationship in Scene 3 and subsequently Scene 13. In Scene 3, an interviewer asks George to complete a hypothetical math problem about a virtual company "Gentech" (19); George answers the question by imagining a world based on the question's stipulations. Scene 13 reveals that the supposedly virtual company Gentech is a fictional particular in Joyce the stockbroker's world (55), and the fictionally existent Gentech of her world is suffering the same financial problems as the virtual Gentech created by the math problem. The fictional virtual Gentech is brought from the virtual space of imagination to the onstage space of fictional facts. Mighton cleverly mingles virtual constituents with fictional constituents, suggesting the two are ontological equals: if a character can think of it, it can be found in one of the infinite possible worlds. Through the interplay of the novum, this invitation is extended to the reader: the dramatic text introduces strangeness and then verifies it as contextually plausible.

George experiences the entire wave function just as the reader does, and so space acts like a "non-holding" wave instead of a static particular. This hints at the unique power of the novum—the reader measures the characters' reactions to the strangeness against their own reaction to the strangeness, and if the characters act plausibly then the strangeness is authenticated through them (Suvin 60–68). Because imaginary and action space are made interchangeable, the text constructs space as diffuse, transient, and wave-like. George implies this when he describes his journey between worlds: "I feel my properties melting, everything I've ever known or felt… nothing holds" (40). Quickly thereafter, the play constructs this same sensation in the action space: "The lights fade on JOYCE, who remains upstage. A man

enters carrying a stone block and sets it down near George" (41). Like the movement of a wave, the previous state lingers as a possibility while the onstage action decoheres into a different particular possible world. The current spatial state does not directly indicate or suggest the next one—shifts can happen at any minute, and the short scenes push this disorientation—but the previous states are also never completely erased or destroyed. When the action returns to Joyce, it is a different Joyce and a different world, highlighting this spatial diffusion. George and Joyce's many relationships lack the fixed spatial anchor that makes kitchen-sink drama possible: the tensions of the broken relationship usually take flesh as a single space experiences the ups and downs of love. Despite spatial uncertainty, time marches forward: every relationship starts, has a honeymoon period, and then ends tragically. The many-worlds interpretation states that classical experiments see deterministic particles because each world is deterministic. Here, *Possible Worlds* is strikingly similar: each world is temporally and causally deterministic if measured in isolation, and the strangeness only comes from stepping back and viewing the in-between space.

Just as the reader can travel into the fictional world by imagining it, *Possible World*'s fictional persons can traverse between worlds through imagination instead of motion. In Scene 2, the neuroscientist Joyce explains the limits of human imagination: "when people see their lives as being different they always make the most trivial changes […such as] if only I had gone to that party or taken that job" (16). Positioned in the action space, Joyce creates an imaginary space of hypothetical other Joyces: the Joyce who went to "that party" or took "that job". George similarly spends the play making trivial adjustments to the "George" and "Joyce" occupying the action space as he looks for the best of all possible relationships. The dramatic text then constructs the same process in the action space. The staging of what should be imaginary suggests that these limits are artificial, and these

imagined worlds are ontologically equal. When *Possible Worlds* represents alternate worlds onstage, it formally empowers the reader with the ability to see invisible worlds across the veil of imagination. Mighton's many-worlds do not establish a metafictional game but rather offer the reader a coherent plurality of worlds stuck in the same forward momentum towards the ending—of relationships and life—made bewildering and real through the tight management of space and time.

3. The nonclassical aesthetic experience of coherence/decoherence

By empowering the reader to witness the entire waveform while characters are stuck in their individual decohered realities, Mighton generates the unique aesthetic experience made possible by *Possible Worlds'* nonclassical speculative world. Without this unique fictional construction, George's myopic search through equally bleak possible worlds could not be represented on stage. Mighton manages George's quest through worlds relying on the devices of novum and chronotope, most specifically by managing what is in coherence (i.e. waveform and combined) and what is in decoherence (separated). Examining how Mighton manages George's travel between worlds demonstrates the aesthetic value of nonclassical fictional worlds.

Many-worlds physicists argue that decoherence—when the "coherent" wave of possibilities separates into "decoherent" individual worlds—is never a complete process. Theoretically, worlds can be weakly coupled by some forces, and, therefore, simple packets of information can travel between them (Deutsch 204–214; Plaga 559). These theories recommend futuristic experiments that could hint at the possibility of inter-world travel. Deutsch, for example, describes an experiment that requires human-level Artificial Intelligence capable of monitoring quantum events without directly measuring them. *Possible Worlds'* fictional world is happy with such speculative thought-experiments, and

borrowing the concept of weak coupling metaphorically describes George's multi-world existence and *Possible World*'s unique aesthetic experience.

George's inter-world travel reflects weak coupling. Unlike other characters, George is not presented as a three-dimensional person but a vague collection of properties—a weak signal sent between worlds. The Joyces regularly reinforce that George appears distant. Neuroscientist Joyce captures this trait beautifully, explaining that George is "so passive—like smoke—I could push my hand right through [him]" (Mighton 45); similarly, stockbroker Joyce complains that George always seems distant, claiming "sometimes when [he] smiles it's aimed a million miles behind [her]" (57). Although the Joyces recognize George's uncertainty, the dramatic content suggests that George's weak presence is less noticeable to the characters than it is to the reader. The final scene emphasizes this product of the reader's superior awareness:

> GEORGE There must be a thousand fossils in these rocks. So many failed ideas . . . You can smell the waste here . . .
>
> JOYCE Tomorrow, if it's nice, we'll go swimming.
>
> GEORGE Sure . . .
>
> JOYCE You're so happy today. (72)

George's dialogue indicates none of the 'happiness' that Joyce mentions. This disparity runs rampant through the text: when characters discuss George as in general terms they accurately capture his vagueness, but when they isolate specific traits their description does not match George's onstage characterization. If George is a weak signal caught between worlds, the discrepancy makes sense: Joyce is interacting with the George of her world, whereas the spectator is only witnessing the coherent (shared) properties of George that fades between each world. The text heavily supports this reading, and indicates that George shifts into

worlds that have a pre-existing George: he appears to cohere momentarily with independently existing Georges and then decohere. Mighton hints towards this property when Joyce recalls events that George cannot (55), and Scene 9 is particularly suggestive: George fades into an alien world filled with "tall, grey being[s], shaped like human[s] but with no nose[s]" (41) and has no recollection of living there before this moment. All that survives this transition in the weak set of coherent George principles. He tries "to be consistent among [his] many lives" (66) by pursuing a relationship with Joyce in each but cannot articulate why. This lack of trans-world mastery and characteristic weakness suggests that George does not decide to enter another world, but rather he is sent to them: "there's a moment, when [his] consciousness shifts", and then "after a few moments [he] becomes adjusted" (Mighton 40).

The unique aesthetic experience afforded by the nonclassical novum makes both of the play's interpretations—there are many actual worlds that George visits or George is imagining other worlds—equivalent. As explained above, the play painstakingly establishes a many-worlds chronotope wherein imagined spaces and onstage spaces are ontological equals: there is no difference between "imagin[ing] killing someone and killing someone" (Mighton 67). If imagination and action are equal, then Penfield's experiment, which could not be explained by the other approaches, is easily captured: Penfield is utilizing George's brain-in-a-jar to send a weak "Georgeness" to other worlds by making him imagine them, thus confirming their existence. Penfield's explanation of his own research supports this reading: "some biologists believe that natural processes create a field of information. Everything you think . . . leave a trace, a disturbance in that field. I'm trying to learn how to control those disturbances" (26). Penfield is not interested in controlling the brain, but rather utilizing the brain's abilities to interact with the "field of information"—the quantum space

that the many-worlds-interpretation interprets as the coherent properties of many different worlds. The disturbances are moments of quantum uncertainty: every time any character makes a decision, there are endless uncertainties at the quantum level that generate a possible world for every possible decision. When Berkley asks if Penfield's research would lead to telepathy, he sardonically replies "Something like that" (26): Penfield seems interested in communication over nonclassical space, and George is conduit to Penfield's ambitions.

Penfield also highlights an uncertainty connection at the base of *Possible Worlds*' multi-world structure: a character must remove his or her measuring apparatuses to move between worlds. The many-worlds interpretation argues that the wave function decoheres into a stable world when the quantum state is measured: either by instrument or, in the case of *Possible Worlds*, human senses. By stealing brains and placing them in the sensory deprivation tanks, Penfield excises their measurement capabilities and thus creates a human-like 'artificial' intelligence as Deutsch calls for in his experiment above. His victims' brains interact with the wave function without triggering decoherence because they cannot measure it. Within his first few lines, Penfield highlights the importance of sensory isolation to his theoretical work: his office is explicitly furnished with "sensory deprivation chamber" where he spends "a lot of time" (25). This deprivation chamber appears to be Penfield's own method of moving between worlds. This way, he too rides the wave function and commits his strange, otherworldly murders; because the murders get increasingly bizarre as the plot progresses, the play suggests that every captured brain increases the efficacy of his cognitive computer.

Penfield's research exposes the remaining structure of *Possible Worlds'* fictional world. With the many-world interpretation as its novum, the multiple onstage worlds are possible worlds created at moments of quantum uncertainty; Penfield and George, encased in

sensory deprivation apparatuses, free themselves from the decoherence caused by measurement and are thusly capable of moving between worlds through imagination instead of motion. The dramatic text considers the implications of trans-world communication methodically, and thus successfully constructs the fictional world on quantum terms.

Conclusion

Possible Worlds' nonclassical fictional world is constructed through Mighton's deft arrangement of dramatic space and imaginary action space. Fixing dramatic time allows Mighton to explore the ramifications of nonclassical space freely without disrupting the reader's ability to piece together the fictional elements of any individual world, or reconstruct the text's fictional world as a many-world wave function. PW fiction theory must downplay the nonclassical space by distributing it into the virtual domain, the domain of information introduced by characters that cannot be verified as fictional fact. This leads to insightful metafictional or mathematical analyzes, but the principle fictionality is sacrificed in the process. Turning to quantum mechanics, understood through the lens of speculative fiction theories, offers an entirely fictional reading of the play that highlights the dramatic text's nonclassical constructional features. PW fiction theory's incompatibility with nonclassical worlds thus demonstrated, the next chapter focuses on a more structurally perverse dramatic text, Stoppard's *Arcadia*, demonstrating how chaos theory, like quantum theories, can be integrated as a nonclassical dramaturgical device.

Chapter 3: *Arcadia* and the Chaos Theory Novum

Rehearsals rarely schedule math lessons. However, Tom Stoppard insisted on daily math classes during the first rehearsal week for *Arcadia*'s 1993 debut in London. The syllabus was not limited to basic arithmetic or Euclidian geometry: rather, Oxford mathematician Dr. Robert May taught the cast the mathematics of deterministic chaos, chaos theory. The lessons were so vital to the show's London success that Stoppard taught chaos theory to the cast himself when *Arcadia* was remounted shortly thereafter in New York (Fleming 192–193). He once stated that chaos theory eliminates the contradiction between believing in "life ruled by determinism" and "life which is subject simply to random causes and effects" by accounting for "the unpredictability of determinism" (qtd. Gussow 84). Chaoticians assert that something can be unpredictable and unrecoverable while also being deterministic. This chapter argues that chaos theory is integral to understanding some of the nonclassical fictional worlds constructed in speculative drama, particularly *Arcadia.*

This chapter examines how *Arcadia* exhibits deterministic chaos as a textual novum, and how that novum in turn constructs the play's plot, characters, and chronotope. In doing so, *Arcadia* constructs a nonclassical fictional world that contradicts the modal expectations of Aristotle's categories and PW fiction theory. Scholars such as William Demastes have explored chaos theory's influence on drama, but they have focused mostly on metaphor and theme. This chapter instead explores how *Arcadia* creates a distinctly nonclassical aesthetic experience by integrating chaotic determinism into its fictional world. Stoppard gives the reader superior spatiotemporal awareness, allowing the reader to witness spatiotemporal relationships that the characters can only hypothesize about from their limited vantage point. Stoppard fixes space to explore nonclassical time and uses this nonclassical world to offer

readers a fictional experience that interrogates the value of human agency in a world ruled by chaotic determinism.

Tom Stoppard

Since *Rosencrantz and Guildenstern are Dead* launched Czech-born British playwright Tom Stoppard's career in 1966, he has tackled an eclectic and challenging mix of themes. Despite lacking formal training in theatre, philosophy, science, or mathematics, he writes plays that wittily explore these disciplines: his plays variously engage with questions of logic (*Rosencrantz*), language games (*After Magritte* [1968]), biographical memory (*Travesties* [1974]), authenticity (*The Real Thing* [1982]), and even quantum mechanics (*Hapgood* [1988]). An equivalent stylistic proclivity matches these diverse interests: elements of comedy of errors, detective stories, literary pastiche, didacticism, realism, montage, and more are found throughout his oeuvre. This diversity reflects Stoppard's stated artistic goal "to have done a bit of absolutely everything" (qtd. Watts 47).

Despite this seemingly chaotic mix of styles and themes, his plays share a common "preoccupation with aesthetics, with the formal properties of play construction, and above all with style" (Fleming 2). Stoppard investigates theatre's aesthetic value in contemporary society by pushing the expressive capabilities of popular genres such as detective stories and weaving together styles to create new theatrical experiences capable of tackling new ideas. However, his plays are not staged essays: they are filled with high stakes and existential dangers that aim to entertain more than educate. Characters, such as Rosencrantz and Guildenstern, often face fictional death (their execution), thematic death (their ontological erasure) and formal death (the end of the play) simultaneously, with tension and danger lurking at every dramaturgical level. Stoppard thus explores the intersection of low-brow

genres and highbrow themes, adding urgency and immediacy to philosophical investigations. In the late 1980s, Stoppard became fascinated with scientific instead of philosophical investigations, and starting with *Hapgood* he began interrogating nonclassical science through his drama.

When Stoppard first read James Gleick's *Chaos* (Fleming 191; Jernigan 114), he probably felt kinship to the pioneering chaos mathematicians. Often his characters face unpredictable futures and unrecoverable pasts—Henry Carr's elusive memory in *Travesties* for example—and these chaoticians had discovered the mathematical equivalent: some systems are so complex, multi-variable, and sensitive that the flow of events from the past to present to future is impossible to recover or predict. Stoppard grew fascinated with chaos theory's ability to seek the middle ground between randomness and order: the world appears unpredictable, but deep within the noise "there was a pattern, with disturbances . . . an orderly disorder" (Gleick 15). Stoppard saw chaos theory as a way to reconcile "the ideas of things not being random on the one hand and yet unpredictable on the other hand" and decided to capture the theory's implications in a new play *Arcadia* (Fleming 19). As characters explore the unpredictable relationship between past and future, *Arcadia* exhibits loose quotations and direct examples from Gleick's *Chaos* (Kramer and Kramer 1–10). It directly discusses chaos theory and employs it as both a metaphor for human life and a structural anchor.

Arcadia

Set in a traditional English country house in Derbyshire, *Arcadia's* action is split across two time periods a century apart; its scenes oscillate between 1809 and the present day. In 1809, Thomasina Coverly, a brilliant thirteen-year old girl, discovers the second law

of thermodynamics and deterministic chaos without having the technology to articulate her ideas. She calls her theory "the New Geometry of Irregular Forms" (Stoppard 36) and approaches the topic with uncomplicated joy. Her tutor, Septimus, navigates extra-marital liaisons with Mrs. Chater, a house guest, and Lady Croom, Thomasina's mother. While Thomasina conceptualizes heat exchange, Septimus discovers that women are heated by sexual desire (6), and this heat makes them addle-brained (12). 1809 plays out like a comedy of manners: upper-class British men become embroiled in love chases and duels. Simultaneously, *Arcadia* entwines the pursuit of intellectual and carnal knowledge: art, science, and sex blend as discussions regularly conflate and confuse the three. Eventually, Thomasina proves that "we are all doomed" (81) because the universe will eventually run out of heat. Satisfied with her intellectual pursuits, she turns to her sexual nature and invites Septimus into her room. Despite loving her, Septimus rebukes her advance, and in the final scene their denied attraction produces too much heat both metaphorically and physically—a fire kills Thomasina and drives Septimus mad.

In the present-day scenes, two scholars attempt to reconstruct Sidley Park's history from records and garden archaeology. Hannah, an independent scholar, researches the park's garden and "the Sidley hermit", whom she has pegged as the symbol of "the nervous breakdown of the Romantic Imagination" (21). Simultaneously, the egotistical professor Bernard searches for evidence that famous poet Lord Byron killed an amateur and cuckolded poet, Erza Chater, in a duel on the house grounds. The reader witnesses the acts of scholarship and the historical events being studied, and so Stoppard twists scholarly misinterpretation into situational comedy. While the academics errantly conduct their research, the modern-day Coverlys, Thomasina's descendants, putter around the grounds: Chloë, an eighteen-year-old airhead, prepares Sidley Park for the yearly Regency-themed

party, their "annual dressing up and general drunkenness" (14); Gus, a genius who stopped talking when he was five, works up the courage to ask Hannah on a date; Valentine, a graduate mathematics student, studies the population dynamics of the park's grouse. Valentine functions as a raisonneur, who explains to Hannah—and thus readers—the basic principles of chaos theory. Through Valentine, Stoppard primes the reader to accept deterministic chaos as the play's novum.

1. Chaos theory as novum

Chaos theory alters what a person can know and not what they can do. *Possible Worlds*' many-worlds novum eliminated the boundary between imagination and reality, shifting the two into a single ontological category (Chapter 2). Comparatively, chaos theory's ramifications are epistemological: it drastically alters what the characters can recover about the past and predict about the future. In everyday systems such as gravity, approximately equal initial conditions cause approximately equal conclusions: Newtonian predictability. In a system of deterministic chaos, approximately equal conditions lead to vastly different conclusions, the nonclassical unpredictability. Chaos theory, therefore, decouples probability from necessity: outcomes that are more probably by everyday logic are not necessary, and what is necessary can seem so improbable it is impossible. Because *Arcadia*'s novum changes what characters can know instead of what they can do, Stoppard includes a character that outlines the domain of knowledge available to the characters. Just as Dr. May taught it to Stoppard's first cast, Valentine lays the foundation required for the reader to verify the play's nonclassical novum and take part in the semantic game that constructs *Arcadia*'s world.

Valentine studies Sidley Park's grouse population by searching for an equation that estimates its year-over growth pattern. His frustrated attempts introduce the reader to chaos

theory conceptually, and his frustrations prepare the reader to deal with the fictional world's chaos. In mathematics, any set of things, such as grouse population, can be studied as a complex dynamical system. Every element that can change the set, availability of food, for example, is interpreted as a variable; by graphing these variables' values at discrete points in time, you record a system's "points". Working off old game books, Valentine maps the grouse system's points on a single graph, connecting points with a line in the pursuit of a pattern. Instead of finding a friendly pattern such as a line or circle, he faces apparent randomness. According to Valentine, this chaos arises because the grouse population is iterative: the final population from one cycle is the beginning population for the next, thus "feeding the solution back into the equation and then solving it again" (37). This process amplifies minor inaccuracies over time, but this iterative nature is also at the heart of chaotic systems. Valentine explains:

> This year there are *x* goldfish. Next year there'll be *y* goldfish. Some get born, some get eaten by herons, whatever. Nature manipulates the *x* and turns it into *y*. Then *y* is your goldfish for your starting population the following year… Your value for *y* becomes your next value for *x* . . . [and as you graph your results] you'd never know where to expect the next dot. . . . but . . . gradually you'd start to see this shape. (Stoppard 38–40)

Classical science is interested in linear, everyday systems wherein cycles act predictably. These systems, like gravity, are crudely similar to a play whose plot follows a pattern of rising and falling action with a climax somewhere near the end. Without knowing every detail, many readers can easily predict the outcome of such a play because the approximate initial conditions point towards the approximate conclusion. Linearity allows classical scientists to "invent an ideal scientific world where regularities can be separated from the

disorder of experience" (Gleick 41). Removing disorder, however, only creates the illusion predictability by redefining variations in outcomes as interference. According to Edward Lorenz's pioneering article "Deterministic Nonperiodic Flow", chaotic systems cannot be estimated this way because "two states differing by imperceptible amounts may eventually evolve into two considerably different states" (133). Systems like Valentine's grouse are unpredictable: a general 'shape' emerges over time, but predictability never improves regardless of the number of cycles.

This unpredictability distinguishes chaotic systems from the everyday, and subsequently informs *Arcadia*'s nonclassical novum. In classical systems, the next dot appears where expected because the pattern emerges after very few states: after a few scenes, for example. In chaotic systems, the pattern does not emerge until you feed it back "say ten thousand times" (Stoppard 40) due to the system's incredible sensitivity, and it may take "a few centuries" or longer of perfect data collection for a chaotic system's pattern to emerge (Lorenz 141). This massive timeframe is the very timeframe the novum exploits: instead of a classical cause and effect narrative emerging in a few scenes, cause and effect emerges slowly over hundreds of fictional years. Valentine primes the reader to study *Arcadia*'s world using the grouse: data must be examined over an extensive time period, and patterns will never lead to predictability.

Valentine, a fictional person, can only access impartial data about *Arcadia*'s world: the temporal dimension of chaos is too vast just as quantum mechanics' spatial dimension is too small—it takes "centuries" to see the effects of small nuances. Valentine's temporal insufficiency is further complicated by the fact that his data collection is far from perfect: the "burning the heather...foxes... weather..." (40–41) all interfere with the natural growth pattern of the grouses. Collecting the variables required to predict the grouse's population

pattern perfectly is impossible because "there's a thousand acres of moorland . . . but nobody counted the grouse" (38). Because the system experiences deterministic chaos, "if, then, there is any error whatever in observing the present state—and in any real system such errors seem inevitable—an acceptable prediction of an instantaneous state in the distant future may well be impossible" (Lorenz 133). The temporal implications of chaos theory are clear: the laws running a system are unrecoverable because the pattern takes far too many human life-times to repeat.

As a textual novum, chaos theory implies that traditional causality is lost, and although action follows a deterministic path it is simultaneously wholly unpredictable and unrecoverable. Primarily, this creates a unique chronotope that shows the chaotic patterns uncovered by Valentine's work. Just as Valentine fixes into one location, Sidley Park, to study the chaotic, random-seeming shapes emerge through centuries of data, *Arcadia*'s chronotope fixes into a singular physical location—Sidley Park's study—to map the changing dynamics of the human population through a century. *Arcadia*'s nonclassical aesthetic experience grows from this chaos theory novum, and is facilitated by a chaos theory chronotope.

2. Chaos theory chronotope

Valentine cannot recover the grouse population's history because his spatiotemporal frame is limited to the play's present era. Stoppard alleviates this limitation for the reader by presenting scenes separated by over one hundred years. *Arcadia's* fictional time and real time scales enter a taught negotiation: fictional time whips back and forth without consistent pacing or pattern, allowing Stoppard to expose relationships that are impossible to witness within a classical fictional time-scale. The most fruitful example of this effect is Bernard's scholarly misinterpretations. Bernard's hypothesis—that Byron killed Chater—hinges on an

inscription Erza Chater wrote in Septimus' copy of his sophomoric poetry collection "The Couch of Eros": "To my friend Septimus, who stood up and gave his best on behalf of the author . . ."(8). From this evidence, Bernard concludes that Septimus could not have killed Chater and so it must have been Byron. Because the reader previously witnessed the inscription's disingenuous context, she or he recognizes Bernard's mistake: Chater was misled when writing the inscription.

Bernard's reasoning is nonetheless undeniably sound: his detective-like parsing of clues is logical and, in a classical world, should solve the mystery. Chaotic determinism, as the text's novum, separates probability (they are likely friends) and necessity (what is shown as fictionally factual). Just like the grouse, there is a causal relationship—Septimus tricking Chater causes Bernard's disgrace—but the effects of Septimus' trickery are not predictable, and from the outcome Septimus' trickery is not a probable cause. Placing two time periods in the action space emphasizes how many small factors—intent, specific personalities, and weather—are lost to time, but nonetheless have massive implications on the system's future. Through these failed acts of recovery, the reader then witnesses a nonclassical flow of time that does not move predictably from event-to-event, but rather moves chaotically as characters, climates, and unexpected visits disconnect cause from effect. This irregular temporality is the defining feature of the chaos theory chronotope, defined by Valentine and portrayed by the text.

Stoppard extends this temporal relationship to the greater scope of human history by drawing parallels between chaos theory and Romanticism, suggesting that mankind cycles between chaos and order. Romanticism marked an artistic and scientific rejection of enlightened regularity, shown in *Arcadia* through the gardener's and Thomasina's rejection of Newton's everyday world in favour of the picturesque and a geometry of irregular forms

respectively. Chaos mathematics similarly rejects traditional physics by emphasizing the irregularities of systems and embracing nonlinearity (Gleick 163). Thomasina directly confronts the early Romanticism in 1812 by convincing Septimus that Newton's universe is incomplete, and Bernard's positivist logic fails to account for human population's chaotic dynamics. By linking the chaos of *Arcadia*'s fictional time to a greater historical trend, Stoppard comments on the concept of historical recovery in the post-chaos world.

For Stoppard, however, equating chaos and Romanticism is more than commentary: he uses the connection to suggest that mankind is itself mapped by a chaotic system, whose steady-state line—the line that best describes statistical data—bifurcates between two states of behaviour. Bifurcation is a common feature of chaotic systems: they have two possible steady states and oscillate between them (Demastes 72). Stoppard asserts that human history is chaotic, and oscillates between an appreciation of chaos and an appreciation of order; similarly, he models his plot after the same oscillations to integrate this history of chaos into the temporal dimension of his chaos theory chronotope.

The sequence of scenes in *Arcadia*'s plot allows Stoppard to map the timescale of a chaotic system within the fictional time of *Arcadia*'s world. The play's structural similarity to chaos theory has been noted by scholars before (Demastes 93; Fleming 195; Melbourne 557), but the effect of this structure of fictional time has been largely uncommented on. The play's nonlinear plot moves unpredictably between two time periods, like a bifurcated system oscillating between two steady states. However, Stoppard avoids constructing a periodic cycle, which is a regular and symmetrical system. While the first four scenes alternate between 1809 and the present day (Scenes 1 and 2 are in 1809, and Scenes 3 and 4 are in the present day), Scenes 4 and 5 are both set in the present. These two scenes are separated by an act break, which is similarly irregular and asymmetrical; the first act has four

scenes while the second act has three, and the first act follows as 1809–present–1809–present pattern while the second act goes present–1809–mixed. Furthermore, Scene 4 and 5—both in the present and flanking the act break—are the longest scenes in the play. Scenes 3 and 6, which flank the pair, are the shortest scenes in the play and are both set in 1809. In total, the present scenes are over two-thirds of the total real time. Despite each period receiving the same number of scenes (three) and beginning in a cyclical pattern, the real time is unequal, and the weight between the time periods is asymmetrical. Like a system experiencing deterministic chaos, the play implies a shape without conforming exactly to it; it is a pattern with disturbances.

This irregularity is compounded by the two quasi-periods, or almost-cycles, that *Arcadia* undergoes. The seventh and final scene increases the rate of bifurcation by breaking into six sub-scenes. Two sub-scenes happen in 1812, two in the present, and two place both time periods on stage simultaneously. The plot thus undergoes two quasi-periods: the first quasi-period (Scenes 1–6) is split between 1809 and the present day at three scenes each, and the second quasi-period (Scene 7's sub-scenes) goes present–1812–mixed–present–1812–mixed. The second quasi-period contains new "mixed" plateaus between the 1812–present oscillations: a common feature of systems as chaos increases. The fact that the act break does not coincide with the period break is also intriguing: the act break interjects into the first quasi-period, and causes the instability that allows two present scenes to occur in a row (Scenes 4 and 5). Just as Valentine was dealing with the burning of heather and weather interfering with the grouse population, here an outside system (theatre convention) has intruded on the system of study (*Arcadia*) causing a moment of noise leading to increased unpredictability (the time period repeat).

These properties—asymmetrical performance weight, equal scenes, uneven pacing—aesthetically represent the mathematical functions of a chaotic system. The resulting tension between fictional time, historical-time, and real time establishes the chaos theory chronotope: in its oscillations, fictional time bridges connections between events that appear isolated and unique, such as Chater's autograph and Bernard's fall from grace. The historical dimensions of this same time span link the trivial events of the play to the greater historical oscillations that humanity experiences as it too moves between order and chaos. Finally, the reader's time is necessarily locked in a forward moving momentum, but that forward movement is drained of its significance because traditional temporal markers of plot progress are missing. Never during the play's action is it clear what the play is moving towards or what the climax will be. The final moment on stage, Thomasina's imminent death, is not foreshadowed at all until scant few pages before it occurs. By removing these markers, Stoppard minimizes the inevitable forward arrow of time and moves the reader towards embracing the nonclassical fictional time.

To establish the temporal dimension of this chronotope, Stoppard must offer the reader spatial fixity. Like Valentine's goldfish example, measuring a fish population requires focusing on a single pond. If space adjusted as often as time disorientation would prevail, and it would be difficult to interpret the action as a chaotic system. Fixing space allows that space to collect and inventory changes through time. In doing so, Stoppard also utilizes space to respect a forward march in time at the "everyday" scale of the characters, just like Mighton fixes the space within each sub-world in *Possible Worlds.* This allows Stoppard to explore the nonclassical aspects of chaotic time visible at the heightened spatiotemporal awareness of the reader while fixed space maintains absolute space and time from the characters' limited perspective.

Within the action space, *Arcadia*'s most profound element is the table centre-stage. This table takes on the flesh of real time as fictional time moves back and forth between eras. At the play's beginning, the table only has a stack of books and an old theodolite on it (1), but "by the end of the play the table has collected an inventory of objects" (13). Each scene involves a dizzying array of props that are abandoned on the table. Stoppard highlights the importance of this in his stage directions: first he makes it explicit "both periods must share the state of the room", before reiterating "there is no absolute need to remove the evidence of one period to make way for another," and finally "what we see should neither change nor contradict" (12). As noted by Prapassaree and Jeffery Kramer, Stoppard repeats the same direction three times to emphasize a key visual image and spatial relationship that is obvious in performance, but subtle in text (6–7). The room is static, and although the anachronistic items on the table are "deemed to have become invisible" (13) to the characters they must not become invisible to the reader. The items reflect the reader's heightened temporal awareness: the space collects the march of time as the system progresses.

The inventory of objects constructs a record of the performance's real time, not the play's fictional time. In the fictional time, objects placed on the table in 1809's Scene 3—such as the pocket knife (30)—were placed there before Bernard's briefcase in Scene 2. However, the pocket knife is not on the table in Scene 2 (present day), but is there Scene 4 (present day) and onwards. The table, a fixed island of regularity and the steady state *Arcadia*'s chaos continuously revolves around, collects the procession of variables and reminds the reader that objects from the past effect the present even if, in everyday logic, they should not. The inventory also encourages the reader to sort information along with the plot—which grows the items on the table—instead of the fictional time. So, instead of tracking events along their fictional temporal trajectory—the 1809 scenes first, then the

present-day scenes—the table fixes the progress of time around the oscillations of the plot. Space offers stability and the reader studies the space through time as Vincent studies grouse on the grounds.

Despite collecting real time, the table refuses to offer a deterministic narrative about that procession. Stoppard coyly undermines assumptions caused by the disparity between the fictional time and the real time by blurring different items' origins. For example, the "old theodolite" (1) resting on the table at the beginning of the first scene looks like it should belong to Thomasina: she is currently working of geometry and mathematics lessons, and the theodolite is of contemporaneous origins. However, every character in the 1809 scenes ignores the theodolite. In Scene 2, Hannah interacts with it in the present day, confirming that it is hers. The theodolite is old because it has accrued fictional time outside of the plot, and it did not add to the knowledge collecting on Sidley Park's table until Hannah brought it in the present day. The table embodies an accruing of information, but one that hides the information's source. Again, Stoppard teases this fact with his stage directions: the furniture in the room "would all be collectible pieces now" but they are not "impressive" in their original context (1). Present-day expectations of these objects lead the reader to suspecting a false history—that furniture would be a collectible now, so it must be valuable then. However, in 1807 Sidley Park the furniture is the family's junk furniture, tossed together for a passable teaching room. Fixing space and presenting different objects through time exposes the falseness of assumptions and the unrecoverability of the past.

Finally, *Arcadia's* chronotope utilizes imaginary action space to comment on chaos as a historical phenomenon, further tying the play's chaos with the real world. The titular garden, the park's arcadia, is placed off-stage and can only be imagined through character reports. A plethora of scholarship already comments heavily on *Arcadia*'s garden

(Melbourne; Müller-Muth; Wheatley) and its metaphorical role in the play's commentary. Through fictional time, the garden is reshaped several times to reflect society's changing views of nature. During the Enlightenment, it is a formal Italian garden with rigid, clean lines and geometric patterns. By 1809, the park faces the transition towards Romanticism and is a curving English garden that pretends to be natural, but is actually a "group[ing] trees at intervals to show them to advantage" that "featur[es] the right amount of sheep" (10). By 1812, Noakes transforms the garden into a Romantic "picturesque style" garden with wild irregularity (10). Finally, the present-day garden has been dissected into trenches because the lady of the house is interested in archaeology and garden history (20). In the final scene, the archaeological garden hosts a party filled with general drunkenness and revelry. Thus, the garden's path is from order (Italian), orderly disorder (English), disorder (picturesque), orderly disorder (the digging process), order (the completed dig trenches), and back to orderly disorder (the party). This path mirrors the same path from Enlightenment to Romanticism, scientific classicism to nonclassical chaos, the scenes of the play moving between two eras, etc. The garden as an imaginary space collects history, but does so with narrative clarity—the garden's layers, exposed by the archaeology, offer a clear narrative. For this reason, Stoppard places the garden entirely in the imaginary space—because narrative recovery is an imaginary act.

Both time periods placed in the action space feature the garden as it transitions between order and disorder: Noakes renovations from English to Picturesque and Hannah's archaeology. Valentine describes such transitional periods as "the best possible time to be alive, when almost everything you thought you knew is wrong" (40). Hannah's research implies that the garden exposes a narrative history: the layers of the dig record the various gardens that once existed. By placing the garden in the imaginary space, Stoppard

emphasizes that such a naïve understanding of historical recovery is equally imaginary. The garden is a true arcadia—a nostalgic past that characters can dream about, but they can never recover nor return to because it is an imagined construct. Characters treat the garden's history as a representation of what they value, and then pine over this lost past. Relegated to imagination, the garden embodies the impossibility of historical recovery that Bernard, Hannah, and Valentine experience.

The garden and table capture the spatiality of the chaos chronotope: the action space must be fixed so changes can be witnessed over time, but this same action space must eradicate any record-keeping as the table does. Change cannot be tied to a clear cause. Similarly, cause and effect markers must be relegated to the realm of virtuals, the imaginary space, where they can remain unverified and naïve. With fixed, the reader can witness the chaotic flow of time and reconstruct a fictional world where necessity and probability are unrelated. With *Arcadia*'s chronotope defined, this chapter now examines the aesthetic experience offered by the nonclassical chaos theory novum. Stoppard utilizes the novum to confront historical recoverability and explore the value of human agency in a deterministic universe.

3. The nonclassical aesthetic experience of chaos theory in time and plot

To examine the value of human agency in a nonclassical world, Stoppard harnesses two fundamental ramifications of chaos theory—the idea that complex systems experience *dense quasi-periodic orbits* and *topological mixing*. The term *dense quasi-periodic orbits* means that two very close points in a system will be very far apart at another time, regardless of how similar their paths currently seem (Gleick 52). This property arises from the asymmetrical cycles the system undergoes, and how densely packed possible cycles are. As a simple example, when the reader sees the theodolite in Scene 1, that theodolite could have

taken two different paths to get there: it can be Thomasina's in 1807 or an antique placed there in the present day. Both possibilities look identical at the beginning of the play, but have very different implications as the play progresses.

Topological mixing is the opposite result; if a system exhibits topological mixing then two very far apart points will be very close together at another time, regardless of how dissimilar their paths currently seem (Gleick 45–46). Thomasina explains this to Septimus, saying "when you stir your rice pudding . . . the spoonful of jam spreads itself round making red trails . . . but if you stir backwards, the jam will not come together again . . . the pudding does not notice and continues to turn pink just as before" (4). As Thomasina stirs, every molecule of jam moves around the pudding until every molecule has been at every point in the pudding at some moment. Stirring any other direction appears relevant at first—the red swirl would be in a different direction—but the result is a uniform pink that entirely obfuscates the path. The pudding, just like a deterministic chaos systems' topology, has been mixed. The play experiences similar mixing in Scene 7, when both time periods share the stage: characters place wine bottles, open books or enter and exit, it is impossible to tell if they're reacting to the activity in their time period or the other. The novum of chaotic determinism says that characters are reacting to their own time period within their temporal frame, but from the reader's enhanced awareness he or she witnesses how century old events also move characters.

Combined, these two features of chaotic systems are known as the butterfly effect. Because the possible paths through the system are quasi-periodic and densely packed and over time different paths mix everywhere, a single approximation or error means "any prediction deteriorates rapidly. Errors and uncertainties multiply, cascading upward" (Gleick 20). Bernard experiences the butterfly effect when his detective work fails, and the reader

experiences it when he or she cannot separate objects into their proper time periods by the play's end. Given the final state of the table, it is functionally impossible to figure out how any given object got there. These properties make chaotic systems incredibly sensitive to initial conditions. Stoppard uses *Arcadia*'s unpredictability to examine the meaning of free-will and human agency, an aesthetic experience born from chaos theory.

In Scene 1, the 1809 characters establish the initial variables that guide the plot in both time periods, despite the fact that the two periods involve action that is only tangentially related. The first scene in dramatic texts often introduces principle conflicts or presents an inciting incident, but this scene introduces trivial events in a comedy of manners style. For example, Chater confronts Septimus after learning that Septimus bedded his wife in the Gazebo. A dramatic question emerges: how will Septimus avoid punishment? However, Septimus quickly neutralizes the confrontation with wit and wordplay; he convinces Chater both that he is a big fan of Chater's poetry and that Chater's wife only seduced him to ensure a positive review of Chater's newest poetry collection "The Couch of Eros" (Stoppard 7). Thus, the affair is rendered inconsequential before the end of the first scene: instead of an inciting incident, the sexual liaison is trivialized into a joke when Septimus confuses an inventory of garden renovations for an inventory of his and Mrs. Chater's sexual conquests (9). The chaotic chain of cause and effect begins: the conventions of dramatic probability (the affair will be the inciting incident) are dashed. Next, the play establishes that Septimus is in love with Thomasina's mother, Lady Croom (12). Instead of Septimus-as-adulterer as the equilibrium, an equilibrium of unrequited love is established, and the play introduces a new dramatic question: will Septimus succeed in winning Lady Croom's heart? The initial affair now appears to be a subplot that just established his wit and playboy demeanor, rendered trivial by a new equilibrium and dramatic question.

Scene 2 then quickly dashes the comedy of errors plot Scene 1 begins by jumping forward a century. This major disconnect in the action trivializes Septimus' love for Lady Croom. It also emphasizes a discordance between real time and dramatic importance: the first scene is the longest block of performance time given to 1809. Its length (12 pages) suggests that it is establishing the action, but the present-day action (which is over two thirds of the performance time) is only tangentially related to the first scene. After abandoning the Scene 1 characters, Scene 2 establishes that Bernard is studying Byron, who is not in Scene 1, and Hannah is studying the Sidley Park Hermit, who does not exist yet in Scene 1. The real time of events is unrelated to their dramatic importance, and *Arcadia* is happy to spend pages on events that will never reach fruition.

More importantly, Stoppard's love of puns points to the key dramaturgical value of opening the play as a comedy of manners. The genre is known for its triviality[1], and chaos theory similarly argues that trivial information today has massive ramifications in the future. Stoppard is teasing the two meanings of trivial. The first scene is trivial, but all of its trivial information chaotically leads to the seemingly unrelated action in the present-day scenes. Scene 1 and Scene 2 are linked by this pun: the *trivial* matters of 1809—in the sense of the genre—are the pieces of trivial information that cascade through the butterfly effect and cause the present-day action. After Septimus placates Chater, Chater signs his copy of "The Couch of Eros"; as the link between this dubious autograph and the present day unravels, Septimus' trivial wit chaotically causes Bernard's academic shame and even Chloë's broken heart (83). Because Bernard is missing trivial information from the previous scene, his sound classical logic is rendered obsolete: approximate conditions—"Chater happily signed Septimus' book" versus "Chater was duped into signing Septimus' book"—mix

[1] According to Wilde who subtitled *Earnest* as *A Trivial Comedy for Serious People*, equally suited to *Arcadia*

topologically and lead to the same end result—Septimus' book was signed. Detective work suggests that the two were friends, but *Arcadia*'s fictional world, organized by chaos, refutes logical recovery. Despite the fictional world being deterministic—there is cause and effect—there is no predictability. The first two scenes immediately establish Stoppard's commentary on human agency in a chaotic world: a trivial act of agency, both in terms of genre and scope, has massive ramifications in the future that are wholly unpredictable.

Whereas romance is trivial in the 1809 scenes, the present-day scenes frame romance as a vestige of human agency: the ultimate triviality with massive consequences. Romance ensures chaos in everyday human life. Chloë, whose innocent demeanour is reminiscent of Thomasina's, brilliantly argues that order gives way to chaos because of "people fancying people who aren't supposed to be a part of the plan" (62). Free will and agency are the trivial bits that make approximation useless, and spin the densely packed possible paths. Stoppard's carefully chosen words emphasize the heart of the fictional world created by chaos theory: Chloë says "fancy" not "love", and emphasizes that fancying someone is a product of "desire". She thus equates sex, not emotional love, with chaos. In the 1809 scenes, this plays out explicitly—the chaos of Septimus' life grows from his (trivial) playboy approach to life. This is why the garden's archeology project cannot recover Sidley Park's true history: while it recovers the broad strokes of renovations, it cannot recover the love trysts in the gazebo or the miscommunication that lead to certain decisions during renovation. Sex, as chaos, shaped the garden in ways that are forever lost. Chloë smartly suggests that necessity—in the form of physical attraction—often defies probability, who people are supposed to fancy, and thus deterministic chaos takes hold.

Stoppard constructs another pun from Chloë's carefully chosen words: in Chloë's English *fancy* means attraction, but in Thomasina's English a *fancy* is an artistic product

motivated by imagination instead of observable life. Thomasina's and Noakes' imaginative fancies, their drawings of the garden and the Sidley Hermit (12), similarly cause unpredictable events. These drawings inspire Hannah's interest in Sidley Park. In 1809, Thomasina draws the hermit as a joke, but the park did not have a hermit until 1812: Septimus, who adopted the hermit identity Thomasina had created as he dedicated his remaining years to proving her theory. The drawing on the map does not depict the hermit, nor can it look like him as it predates Septimus' transformation into the hermit. Late in the play, however, Hannah confirms her suspicion that Septimus was the hermit after seeing his portrait by Thomasina (85). Hannah believes that Septimus' portrait and the hermit on the map look similar. According to Septimus, however, the portrait is a "not so good" (75) likeness: the portrait and the hermit on the map look similar because Thomasina drew both, not because they are the same person. The cause of the similarities and the cause of the Hermit are lost to Hannah but obvious to the reader because of their elevated spatiotemporal awareness. Hannah concludes that the hermit had been "placed in the landscape exactly as one might place a pottery gnome" (23). Humorously, Noakes planned to hire a hermit, but the drawing is not an indication of that plan (74). Hannah's conclusions are fictionally correct, but her evidence and reasoning is entirely incorrect. Unrelated pieces of data (the portrait, the hermitage, the drawing of the hermit, Thomasina's proofs) are separate in the past storyline, but arbitrarily close in the present: topologically mixed into Hannah's fancied hermit. The proof temporally predates the actual events themselves, and the chaotic effects of imaginative fancy are brought to light in a second way: Thomasina's imagination, the drawing of the Hermit, has a butterfly effect that massively changes the future. Again, human agency is shown as a precious thing that can create massive ramifications through trivial decisions. Additionally, Hannah's accidental recovery shows that chaos is not an evil force

that ensures failed careers and broken hearts, but it is rather an apathetic force that influences everything.

Although Septimus "picks up" (32) what he learned from Thomasina and dedicates himself to proving her theory of heat dissipation, Hannah assumes his work is cabalistic madness instead of genius because he was a hermit in the Romantic garden. If Hannah had assumed the hermit was simply an intellectual living through penance, she could have seen those same mathematical proofs as evidence of brilliance. Her diagnosis of the hermit as a peg for the Romantic sham is misplaced; Septimus was not torn up by Romantic irregularity, but trying to prove it. In this way, the life of a repentant intellectual and a crazy hermit are arbitrarily close from an outsider's perspective, and so Hannah cannot accurately predict which one the Sidley Hermit was. The novum allows Stoppard to interrogate agency in the act of historical recovery: with two possible densely packed paths available, Hannah must choose which one to believe and act accordingly. In the face of irreconcilable narratives, an unrecoverable past, and an unpredictable future, *Arcadia*'s characters must choose and act, in love and scholarship.

The climax of the play, which happens in both time periods simultaneously, offers *Arcadia*'s greatest insight into human agency. Prior to the climax, Scene 6 shows Septimus making romantic progress with Lady Croom. In the final scene, Septimus has inexplicably abandoned his quest for her heart, and she had moved on to yet another lover. Septimus' attraction now falls on Thomasina, spurred by her brilliance. In the same scene, the play introduces an unpredictable danger: the present-day characters unveil that Thomasina burned to death on the same night the final scene takes place. Septimus hands Thomasina a candle, sealing this fate, but her death has never been alluded to before this final scene: it answers no dramatic questions introduced in any previous scene, and it seems like a random conclusion

to the tale. However, Septimus, who taught Thomasina about carnal embrace and mathematics alike, is the only person capable of matching Thomasina both intellectually and carnally. As Thomasina bemoans early in the play, "it is disgusting and incomprehensible. Now when I am grown to practise [sex] myself I shall never do so without thinking of you" (3). Every act Septimus takes in front of Thomasina leads to him being the only man she could love: an entirely unintended and unpredictable effect. As the past moves towards Thomasina's death, the present day changes violently: Bernard's intellectual pursuits are dashed because Hannah exposes his fraudulence (78), and his sexual desires are dashed when Chloë's mother catches the pair embracing (83). Where Septimus accidentally causes Thomasina to love him, Bernard's overt attempt to force a cause and effect narrative on Chloë and Sidley Park's history unravels him. Again, the effect is unpredictable and unintentional.

Septimus denies Thomasina's sexual advances, and their tense encounter eventually causes the fire that consumes both their lives. Bernard embraces Chloë despite disliking her, and he ends the play desperate, defeated, and alone. In exercising his agency and denying his desires out of rational duty to their teacher/student relationship, Septimus condemns the pair to obliteration—Thomasina to fire and himself to the hermitage. Bernard similarly follows sexual desire while denying his rational needs by engaging with a girl he dislikes and engaging in dishonest academics. Here, *Arcadia* integrates the two threads it weaves together for its entire length—intellect (order) and sex (chaos). When one is respected at the expense of the other, the results are disastrous. The play suggests that the tight negotiation, the in-between space that Valentine lauds as the best time to be alive, is where humans must strive to be. To act both intellectually and sexually, in equal measure, oscillating between the two states.

During the climax, Stoppard demonstrates the unpredictable and chaotic force of human agency through Augustus and Gus—two characters that share a single actor. Gus is introduced before Augustus, and Augustus is the only past character who is not introduced in the first scene. This deliberate inversion formally emphasizes the issues of recoverability brought to light by chaos theory: as the reader views Augustus in the past, they compare Augustus to Gus in the present and conclude that Augustus seems to be Gus' opposite, even though Gus does not exist from Augustus' point of view. The reader is forced to predict the past from the future, instead of witnessing other character's failed attempts. The reader predicts Augustus' personality from Gus' characterization, and any prediction spurred by approximately equal data (their shared body) fails. Where Gus avoids people, Augustus draws naked women in art class and openly argues with Septimus, telling him "I am visiting your lesson by my free will" (68). Stoppard enhances this through tightly choreographed entrances and exits: first Gus leaves the present-day room dressed in Regency garb for a party (62); soon thereafter, the play transitions to 1812 and "Lord Augustus, fifteen years old, wearing clothes of 1812, bursts in through the non-music room door. He is laughing" (65). Augustus enters from the same direction Gus exits, wearing the same clothing. The startling entrance is the first time the play shifts time period mid-scene, the first example of double-casting, and the first time Augustus is mentioned. Stoppard ensures that the reader will confuse Augustus for Gus until Augustus acts differently, and thus ensures the moment of failed recovery. The reader is forced to confront her or his own decisions of agency and witness that they recover the past by filtering it through the present.

After Augustus exits, the action turns back to the present day, wherein Chloë enters in search of Gus. From the reader's perspective Augustus, not Gus, just exited. Augustus then returns, acting "cautious and diffident" (Gus' personality) because he wants Septimus to

teach him how to seduce women (76). Septimus gives Augustus his portrait, and the play ends with Gus entering and handing Hannah the same portrait, thus completing her research. When Gus enters this final time, he "thrusts this present at her" with Augustus' confidence and then offers her a waltz—the same dance Septimus offers Thomasina when their sexual tension peaks (84–85). By sharing one body through two characters, *Arcadia* emphasizes how an arbitrarily similar point (the body of the character) can diverge wildly (their personalities, their time periods) but ultimately showcase topological mixing, when the chain of cause and effect becomes tangled and unmanageable. The single body helps the reader track the chaotic course of cause and effect through a century of fictional time in a single space. Augustus/Gus manage to sidestep the trap of human agency that defeats Septimus and Bernard: by helping Hannah with her intellectual pursuits before engaging in a carnal pursuit, Gus integrates both the chaos and the order, the past and the present, intellect and sex. Chaotically and unpredictably oscillating between these binaries is an aesthetic experience constructed through the nonclassical novum brought by Stoppard's integration of chaos theory.

Conclusion

Arcadia's world's construction separates cause and effect from probability. In classical world construction, the initial state of affairs establishes the conditions of subjective probability that guide the dramatic action through the fictional world's most probable route. *Arcadia*'s initial state of affairs instead establishes the plot expectations and fanciful trivialities of a comedy of manners before abandoning the genre. Soon, the play proves that trivial causes can have massive, non-trivial effects: Septimus introduces Thomasina to sex because he was caught with Mrs. Chater, and this introduction establishes the foundation for

their sexual relationship and eventual destruction. The play's bifurcated pattern shows both periods in tandem, allowing the action space to expose that characters are limited by their spatiotemporal scope and unable to see the chaotic patterns. The plot, structured by chaos theory as a textual novum, encourages readers to accept the same: the action is related and continuous despite appearing nonlinear and chaotic. This defies the modal conditions of contemporary fiction theory, which would describe this interaction as non-felicitous: the play's characters and settings suggest a natural world following the law of minimal departure, while the plot demands that the reader forge complex causal links separated by hundreds of fictional years. *Arcadia* and *Possible Worlds* both rely on placing the reader in a superior position of spatiotemporal awareness to construct their chronotope from the novum and subsequently describe the fictional world. The final case study questions this approach by examining a play that places the characters in congruence with the reader, thus denying the reader the ability to piece together patterns outside the scope of everyday existence.

Chapter 4: *Homebody/Kabul*, the Uncertainty Principle and Time-Frequency Analysis

Both *Possible Worlds* and *Arcadia* place the reader in a superior position of spatiotemporal awareness, lifting him or her above the Newtonian everyday limits that bind the characters. *Possible Worlds*' many Joyces and *Arcadia*'s Bernard are not aware of the nonclassical space or time because the characters are restricted by the same limits real people face in the real world. *Possible Worlds* does this by fixing time in a forward arrow to explore nonclassical space, and *Arcadia* the opposite. Fixing one variable is helpful because it lets the text and reader alike isolate the effects of a nonclassical alteration. A question, however, remains: does a nonclassical world require regularity on one of its axes, or can a novum simultaneously construct nonclassical space and nonclassical time? This chapter argues that Tony Kusher's *Homebody/Kabul* creates a nonclassical fictional world by rendering both space and time as uncertain.

Homebody/Kabul (2001) constructs a fictional world that features both irregular space and time by limiting the reader's spatiotemporal awareness to that of the fictional persons. Mighton and Stoppard, propelled by mathematical and scientific questions, give readers an observational scope that exposes patterns across traditionally inaccessible boundaries. This heightened position allows both plays to construct a nonclassical world that appears objectively definable. This approach offers an objective-seeming solution to some incredible speculations: the many-worlds interpretation and chaos theory are shown to be true within these plays. Comparatively, Kushner's dramaturgy rebukes any theory that claims "one idea for the whole world" (Kushner 138). His interests are more philosophical than scientific, and through *Homebody/Kabul* he celebrates a subjectivized postmodern worldview by employing a limited spatiotemporal awareness. This subjectivized worldview seems inherently incompatible with the lofty scope found in *Possible Worlds* and *Arcadia*

because that scope privileges sweeping theoretical accounts. With the perspective thus limited, the reader must reconstruct *Homebody/Kabul*'s fictional world from the characters' actions, language, and behaviour; it follows that the play requires more rigorous reconstructive activity from the reader. A speculative uncertainty lingers beneath these dramatic elements, and it also manifests in *Homebody/Kabul*'s space and time. Therefore, this chapter proposes to study *Homebody/Kabul* as a speculative drama that constructs an irregular world with uncertainty as its novum.

Time-frequency analysis—a mathematical technique that overcomes Heisenberg's uncertainty principle—demonstrates how *Homebody/Kabul*'s characters similarly adopt techniques to cope with the dramatic world's uncertainty. While Kushner has never expressed interest in contemporary science, applying its paradigms to his work has precedent: William Demastes argues that Kushner's *Angels in America* demonstrates that "it is unquestionably clear . . . that [he] has absorbed" a sense of contemporary nonclassical scientific paradigms (159).[1] Reading *Homebody/Kabul* as a speculative drama with uncertainty as its novum demonstrates how the previous chapters' scientific theories can help describe nonclassical worlds that do not declare an interest in science. Speculative fiction theories describe this world without pinning it down to a structural rigidity Kushner may have never attended. Examined thusly, *Homebody/Kabul*'s novum of uncertainty allows Kushner to explore history, language, and politics in a post-quantum world.

[1] Demastes argues that Kushner likely absorbed a popular culture sense of irregular scientific theories through the zeitgeist (159), but it seems more likely that Kushner's familiarity stems from his expressed admiration of Walter Benjamin's anti-deterministic social philosophy, which views history as an uncertain calamity (Weber 119)

Tony Kushner

Kushner's career exploded when his Pulitzer prize-winning anti-Reaganism epic *Angels in America: A Gay Fantasia on National Themes* (1993) met with international adoration. It established the "bracing intellectualism, lyricism, seriousness (tempered with the outrageously hilarious), and political activism" (Fisher, *The Theatre of Tony Kushner* 2) that would come to define his aesthetic. His idiosyncratic conflations of genres and literary traditions merge traces of disparate influences from "Bertolt Brecht's Marxist stage epics" to "the lyrical phantasmagorias of Tennessee Williams" and "Yiddish theater" (Bloom 1): an approach most critics call postmodern. He produces exotic and flexible dramatic worlds: kitchen-sink realism and family drama flirts with spiritually-informed surrealism, like *Angel in America*'s poignant deathbed agonies interrupted by orgiastic angels from heaven. Scholarship never frames his work as speculative fiction, but his plays exhibit elements of the fantastic (Chapter 1): *Angels in America*'s or *A Dybukk's* (1997) reader is never certain if the titular spirits are dreams, hallucinations, metaphorical manifestations, or otherworldly fictional beings. Kushner blends heightened reality with bizarre fantasy to generate wry political commentary, his "neo-socialist" politics "never far from the surface" (Fisher, *The Theatre of Tony Kushner* 4).

Political dramaturgy owing to Brecht's "Marxist stage epics" (Bloom 1) permeates Kushner's oeuvre prior to *Homebody/Kabul;* he has stated that politics "produce good aesthetics, and really good aesthetics . . . [will] probably produce truth, which is to say, progressive politics" (Fisher, *Understanding Tony Kushner* 64). This belief in art's capacity for meaningful positive political intervention partially grows from his time at New York University's Tisch School of the Arts, where he completed an MFA in directing under the tutelage of Carl Weber: Brecht's previous directing assistant and dramaturg. Brecht's

materialist dialectics are evident in Kushner's early plays including *Angels in America*. Echoing the sentiments from Brecht's *Kleines Organon für das Theater,* Kushner has defined theatre as the "art of dialectic" (Bommer et al. 210; Myers 236) and suggests that dialectical processes move the community "towards necessary changes" (8). Towards these goals, Kushner posits that Brecht's epic theatre offers a "sort of clarity [that is] very dialectical and firmly rooted in the Enlightenment and in a kind of rationality . . . [that is] ethical and not obfuscating or obscurantist" (Weber 107); he asserts that Brecht's sweeping objective scope and disparate characters, which Kushner poetically calls the "terribly grandiose prism", can dramatically recover the chains of cause and effect leading to contemporary injustices (Weber 107). These ideals seem indebted to the same positivist hopes that birthed Newton's regular world and the principle of cause and effect. The dialectical materialist looks at human history as Newton does the falling apple: it is a rational deterministic system that can be quantified and thereafter predicted. Therefore, Kushner lauds the very structures this thesis aims to question. *Homebody/Kabul* is precisely so intriguing because it clashes with this background.

Homebody/Kabul

Homebody/Kabul, while political in dramatic content, structurally and thematically rejects the positivist faith in cause and effect Kushner extolls above; even the play's strange premiere refutes simplistic causal understanding. Despite starting life in 1998 as the one-act one-woman play *Homebody*, *Homebody/Kabul*'s premiere[2] attracted media attention for being set in Taliban-controlled Afghanistan when opening only three months after 9/11. The

[2] Since its controversial opening, the play has been revised, and eight different productions and drafts of *Homebody/Kabul* were performed between 2001 and 2004 (Fisher, "'Succumbing to Luxury'" 191).

play serendipitously became a hotbed for politically charged discussion over America's renewed interest in the Islamic Middle East, and early critics reacted by labeling it everything from the "most important play in the last decade" to "pro-Taliban propaganda" (Juntunen 172). Kushner's Brechtian history, neo-socialist politics and acerbic anti-Bush interviews do, admittedly, invite focus on the play's public reception (Juntunen; Reston) or political themes (Minwalla; Philips). However, focusing on the play's politics ignores that Kushner was intellectually drawn to Kabul at least four years before 9/11, when average Americans were still unconcerned with the country (Juntunen 174); the play's prescient political commentary is a coincidental convergence of world events and Kushner's aesthetic interests. On opening night, Kushner issued an uncharacteristic public statement asserting that the play's politics are secondary, urging spectators to consider the play as one ". . . about knowledge and learning through *seeking out strangeness*, about trying to escape the unhappiness of one's life through an encounter with *Otherness*. . ." (Kushner 142, emphasis added). His vague description highlights that Kabul's strangeness and Otherness should draw more dramaturgical focus than its politics.

The *Homebody* monodrama remains as *Homebody/Kabul*'s first scene: an hour-long monologue delivered by a middle-aged Briton known only as Homebody. It oscillates between the domestic tragedy of her unhappy marriage and suicidal daughter, and an outdated guidebook's neatly-arranged history of Kabul. The memoir section myopically recounts a party she hosts to celebrate her husband "having completed some joyless task at his place of business" (Kushner 14) and offers little context: her husband and daughter are not fleshed out fictional persons but furnishings within her tale of middle class ennui. Conversely, when she reads the history of Kabul, she passionately relays a rush of events in a chain of cause and effect, sweeping through tribal warfare, regime changes, and demographic

shifts. Whereas the memoir hints at personal unhappiness through a relatively mundane event, the history of Kabul conveys little feeling about its masses of data: the guidebook offers a flood of information stripped of empathy, accumulated data that glibly solves problems of causality. Extolling the virtues of the guidebook's principle cause and effect, Homebody exclaims: "Ah, now I see what that was all about. Ah, now, now I see why we suffered so back then, now I see what we went through" (11–12). *Homebody* oscillates between these two storytelling formats—suggestive ennui and blunt history—until a chance meeting with an Afghan refugee merges the two stories into a surreal adventure through Kabul that exposes the naivety of her guidebook's prescriptive historicism; historical certainty is exposed as a luxurious product of Western distance and privilege that denies the chaos and uncertainty running through such violent histories.

Homebody's structure superficially reflects the positivist dialectics Kushner inherits from Brecht: two opposing forces are contrasted and ultimately synthesized. In dialectical materialism, this synthesis is supposed to lead to positive progress and eventual revolution. In *Homebody,* the act of synthesis—the merging of the two storytelling formats—is nothing more than an imaginary trip Homebody invents to assuage her feelings of middleclass guilt (Kushner 28). The moment of synthesis refutes rather than ratifies the dialectical principles of cause and effect by showing its authority over violent histories as fallacious and naïve—a similar conclusion *Arcadia* came to by placing cause and effect in the imaginary space (Chapter 3). Because the synthesis fails to offer a way forward, the play strands Homebody in an uncertain territory between unrecoverable history and an unknowable future.

The plot also bifurcates between *Homebody* and *Kabul.* The play's lengthy remainder follows Homebody's network engineer husband, Milton and their suicidal daughter, Priscilla, as they search for Homebody's remains. After a non-dramatized family argument,

Homebody flees to Kabul where she is apparently beaten to death and dismembered for listening to impious music. Priscilla refuses to believe the official story and takes to Kabul's war-torn streets, which mirror her relationship with her parents as they frustrate her attempts to find the truth. In a stark contrast to the long opening monodrama, Priscilla's investigation introduces a rush of characters, many of which are only in a single scene. An Esperanto-speaking mahram (male escort for females), Khwaja, helps Priscilla learn that her mother may have married a Muslim, converted to Islam, and renounced her old life; the closest she comes to confirming this new version of events is finding an ex-wife of this supposed new husband, a librarian named Mahala. Unnavigable cultural, linguistic and political crossroads block Priscilla's investigation and she is ultimately unable to recover her mother's fate from the debris. Homebody is left ontologically uncertain—she could be alive or dead, Christian or Muslim, in Kabul or elsewhere.

While Priscilla plays detective, Milton—certain that his wife is dead and annoyed at Priscilla's insistence—hides in a hotel drinking contraband alcohol and taking opium and heroin with Quango Twistleton, an unofficial British liaison in Kabul. Priscilla's and Milton's strained relationship snaps as an emboldened Priscilla admits to a previous abortion, and while the two ultimately unite to deliver Mahala to refuge in England, they leave Kabul alienated from one another. Mirroring *Homebody, Kabul* oscillates between Milton and Priscilla, exhibiting a bifurcated back-and-forth instead of an Aristotelian cause and effect scene structure.

As previously noted by Scott Philips, *Homebody/Kabul* abandons the "materialist's faith in the capacity for progressive human intervention" (1) that marks Kushner's earlier work. In turn, the play embraces the chaotic macrostructures seen in *Arcadia*. Philips interprets Kushner's turn as one towards pessimism, arguing that a world-weary Kushner

opts to construct a cyclical dramatic world doomed to a postmodern crisis of cycles of violence (2). Kushner disagrees, calling *Homebody/Kabul* an "optimistic" play that aims to "show how bad things are without creating despair" (Leith 2002). This contradiction introduces a new question about *Homebody/Kabul*'s world: where is the room for optimism in a world as ruinous as Kushner's vision of Kabul, and how can Philip's postmodern crisis be read as a glimpse of hope? This chapter argues that *Homebody/Kabul* constructs a nonclassical world with the uncertainty principle as its novum. By introducing the concept of time-frequency analysis, Kushner utilizes an uncertain world to explore varying methods of coping with this existential uncertainty.

1. Uncertainty principle as novum, time-frequency as coping mechanism

Homebody/Kabul happily presents uncertain mysteries without resolving them. Milton, however, uses mathematical models to hide uncertainty with a technique called time-frequency analysis. In the early 20th century, Heisenberg, Schrödinger and others variously discovered that the physical nature of waves makes them difficult to measure (Chapter 2). Heisenberg's uncertainty principle succinctly describes this phenomenon: time and frequency are complementary variables, and so precision on one axis causes imprecision on the other. According to mathematician Karlheinz Gröchenig, scientists that work with waves use time-frequency analysis to overcome "some counterintuitive obstacles in the form of the uncertainty principle" (21). In essence, time-frequency analysis artificially restores certainty to the uncertain phenomena of the actual world. Milton's late play explanation of the same technique offers valuable insight into how *Homebody/Kabul* constructs an irregular world without offering the reader superior spatiotemporal awareness.

Initially the play seems to disregard Milton. Homebody mentions that his career involves the "routing of multiplēē expressive electronic tone signals at extraordinary speeds

across millions upon millions of kilometers of wire and cable and fibre and space" (14)—opining that the description sounds far more exciting than anything her husband does could actually be—and thereafter Milton spends the play in his hotel room in an opiate-fueled haze. His narrative function is limited: he agitates Priscilla into leaving and acts as interlocutor to Quango's depressive politics, but he lacks nuanced characterization and seems conceptually static. The final scene then plucks Milton from the hotel room, and places him at the Khyber Pass, where Mahala goads him into explaining time-frequency analysis:

> In order to, to *banish confusion* . . . in my work we have things which we call "duals" . . . pairs of two things which are alike but opposite. [For example,] Frequency is one thing, it occupies the dimension of space. And time is another, the opposite of space—and yet in computer network engineering, these two opposites may be looked at as a dual, as a single thing . . . (120).

According to Milton, the result of this process is "reducing the unmediated slovenly complexities which exist, let us say, analogically in space, by making of complicated nuanced things their simple non-nuanced identicals" (Kushner 125). If Milton were a translator, this system allows him to retain the principle semantic content of a document while dismissing anything lost in translation as unnecessary and unimportant "nuance". However, the "nuance" lost in Milton's work is physical reality's inherent uncertainty; by translating the physical world into a mathematical map, he is able to manipulate variables and hide uncertainty.

Does Milton, bestowed with knowledge capable of describing the world's irregularity, function in an analogous fashion to George in *Possible Worlds* and Vincent in *Arcadia*? Kushner acknowledges that Milton's "explanation of electronic engineering . . . [speaks] . . . to the heart of the play" (xiv) and such authoritative characters are invaluable to

the world-constructing enterprise: especially when readers are reconstructing the fictional world from a position of limited awareness (Doležel 154). Yet despite indicating the uncertainty principle, Milton does not describe it: he only introduces a method of overcoming it and thusly introduces uncertainty through its negation. Analogously, it is as if *Arcadia's* Valentine introduced population mechanics while disregarding irregularities, leaving readers to identify these irregularities themselves. By focusing on the negation, Kushner constructs an environment that dodges singular readings and totalizing theories while encouraging the reader towards a more engaged reconstructive process. If uncertainty was defined in certain terms, the text would encourage a position of superior awareness and subsequently push the reader outside of the world into an observational role.

Kushner amplifies this effect by placing Milton's diatribe in the last scene. The reader is forced to construct the text's world and make his or her own decisions before Milton's theory offers the reader Kushner's key to the world's uncertainty. Kushner similarly delays addressing the play's guiding themes until the final pages of the epilogue. Priscilla defiantly tells Mahala, the new non-nuanced identical Homebody, that the Taliban is "what Afghanistan needs" because Afghanistan is a land of uncertainty and it's worth "anything for certainty"—even tyranny—because "uncertainty kills" (138). Mahala offers a more nuanced counterpoint: "as does certainty. They're like communists, the Taliban. One idea for the whole world" (138). Kushner moves both the scientific frame and his thematic perspective to the play's final scene and epilogue to avoid hypocritically enforcing his view onto the reader's reconstruction process.

The novum of uncertainty therefore leads the reader to work with a limited awareness, a lack of scientific frame, and no thematic guidance. The reader's reconstructive activities become the primary constructive work occurring around the text. The emphasized

reader is reflective again of quantum mechanics, wherein the scientist's decision to analyze phenomena is a complicit part of the phenomenon measured. The novum thrives in this very environment: when more reconstructive activity is placed on the reader, the semantic game of the novum eases the world construction process.

According to Suvin's theory of the novum, when Milton's mathematical model is introduced, the reader measures Milton's mathematics against the patterns displayed by the world of the play before this moment. If the reader ratifies the strangeness of Milton's mathematics theory with the world displayed by the text, she or he can reconstruct the fictional world. Prior to Milton's lecture, Kushner peppers the play with events that expose Milton's discomfort with uncertainty, and thus hint indirectly at uncertainty's presence: he spends the play in a "luxurious" hotel room that mirrors their London home (31); he replaces Homebody's ontological uncertainty with the fact that "[he is] unmarried" (42, 102) and thus the "certainty" that she is gone to him masks her uncertain fate; he returns to London with a new Homebody, Mahala, and thus restores his life to its non-nuanced status quo. Most damningly, Milton lashes out at Priscilla for her secret abortion in the climax of the family drama (94): he is content being grandchild-less (102), but this aborted grandchild is an uncertain possible child he can never know. He cannot strip this incursion of its nuance, so he must banish Priscilla from his life. Milton thus maintains regularity and normalcy—the Newtonian world—by stripping uncertain dramatic elements of their nuance and rendering them 'certain to him'. This pervasive coping strategy hints that there exists an uncertain structure beneath Milton's classicist bravado; his distaste for mathematical uncertainty mirrors his distaste for actual uncertainty. Thus, Milton's mathematical theories are reflected in his fictional life. According to Suvin's theory, Milton's process of time-frequency analysis points towards a novum—the speculated element of uncertainty—fueling his actions.

Kushner swiftly undermines time-frequency analysis' ability to offer every character the sort of consolation it gives Milton. Milton says that replacing nuanced objects with their non-nuanced identicals "banish[es] confusion" (120), but this conclusion is ironically undermined when he explains this theory to Mahala. Instead of banishing confusion, Milton's explanation causes it: linguistic barriers prevent Mahala from grasping the concept. Kushner slyly implies that Milton's mathematics do not overcome uncertainty but merely hide it; similarly, Milton's scientific language hides uncertainty by inventing new words and theories. Uncertainty just shifts into the model's gaps or language's nuance. This failure mirrors Homebody's ontological uncertainty. She is similarly situated within duals and the synthesis of these "opposite things" into "a single thing" does not "banish confusion" but rather perpetuates it. When Priscilla's detective work fails to recover Homebody's fate in everyday terms, the reader compares Homebody's strangeness to the world's strangeness. By the play's end, such re-constructive activity reveals that uncertainty fuels far more characters than Milton and Homebody: just as Milton utilizes time-frequency analysis to overcome quantum uncertainty, Khwaja learns Esperanto to overcome linguistic uncertainty, Mahala flees Afghanistan to overcome Kabul's intellectual uncertainty, and Quango uses opium to find peace from the chaos of Kabuli life. Each character's approach is different, but their tenuous successes and lingering failures are all suggestive of the same world structure constraining their activity: the uncertainty novum.

Limiting the reader's spatiotemporal scope to congruence with the fictional persons generates uncertainty through its absence, as the reader witnesses multiple characters reacting to the same existential threat. This same congruence also allows Kushner to construct the unique chronotope generated by his uncertainty novum—a chronotope of

uncertainty where neither space nor time is absolute. This chronotope denies Newtonian expectations while still constructing a fictional world.

2. Uncertainty principle chronotope

By denying the reader a broad overview, Kushner can construct a world that is spatially and temporally irregular by alternating between fixed perspectives. This tactic is highlighted by Milton's and Priscilla's disparate approaches to battling against uncertainty. Following the uncertainty principle, each character fixes one complementary variable and accepts vagueness on the other. Milton fixes space by staying in a luxurious hotel room, an ersatz London, and time subsequently becomes inaccurate and amorphous. Traditional markers such as sleep (71) are directly disrupted and, as Milton falls deeper into heroin use (97), stage directions only indicate time vaguely with "*meanwhile*" (51) or "*later*" (97). The most concrete time marker is "*the next morning*" (71), but it is prompted by a momentary sobriety. The chronotope of the "opium den" allows fictional persons to stay in the timeless sense of "[riding a] flying carpet over minarets in the moonlight" (97) while spatially fixed by the drug's locale.

Comparatively, Priscilla's detective work reflects detective fiction's episodic chronotope: she discovers one new clue in each scene: she finds a mahram (50), pervasive violence (58), her mother's apparent message to her (69), the fact that her mother apparently remarried and converted (82), Mahala (83), and finally reaches the location marked on her mother's map, which was amongst her belongings (111). Time is marked by her progress through this quest and is reinforced by comparatively accurate stage directions: "*several hours later*" (55), *"so late at night it's nearly dawn*" (111). Most effectively, Priscilla appears in three consecutive scenes in Act 2—Scenes 4 through 6—generating a brief sense of cause and effect when Priscilla's investigation reaches its unsatisfying conclusion. Then

the play returns to its myopic oscillations. Throughout her quest, space is defused: every scene is in a different location, ranging from small rooms to ruined streets to a "rather elegant room" (83) and space is subsequently fractured with no sense of the distance between various unrelated points. She directly recognizes this loss of spatial fidelity: after Khwaja points out pillars commemorating the slaughter of soldiers from 1841, she remarks "we already passed the pillars . . . hours and hours ago. Are we going in circles?" (55).

Alternating between two limited spatiotemporal views allows Kushner to suggest a greater uncertainty chronotope: any aspect of the world that appears 'fixed' is not fixed in principle but rather fixed by that character's coping mechanisms. By suggesting that fixing time or space is arbitrary, *Homebody/Kabul*'s chronotope indicates that the true nature of the world is uncertain and amorphous. The chronotope helps construct a postmodern world wherein subjectivized views anchor the individual in an otherwise uncertain, unknowable reality. Furthermore, by making each character confront uncertainty through a different medium—scientific, personal, linguistic, and historical—Kushner smartly ties together disparate disciplines and suggests that uncertainty is an underlying force informing all human activity. Stoppard's *Arcadia* forges a connection between the Picaresque gardener, chaos mathematician, and romantic poet, united together by their interests in chaos; Kushner extends this picture by introducing uncertainty as an underlying world structure that surfaces in science, history, and even language. Language is especially important because Kushner, often commended for his lyricism, likely understands network analysis as it relates to aesthetic language.

This uncertainty novum and its resulting chronotope allow Kushner to create a nonclassical aesthetic experience that fictionally interrogates the role of language as a measuring device. How can language, an imprecise tool, describe an imprecise reality? When

Milton fumbles to explain how his science "banishes confusion", Kushner exposes classical sciences' willingness to hide uncertainty without overcoming it; this simultaneously indicates that language is incapable of precise communication. Language perpetuates the same uncertainty. Time-frequency analysis offers strong footing for such an understanding of language: Gröchenig argues that "the use of [the language] of classical physics may lead to paradoxical and counterintuitive conclusions" because "the language of Newtonian physics cannot adequately describe physical phenomena at the microscopic level" (36). Put simply, Gröchenig blames language, not the physical universe, for uncertainties' paradoxes. However, while Gröchenig sees an ultimately certain universe being rendered paradoxical by language, *Homebody/Kabul* shows that language is imprecise because it perpetuates the uncertainty that is component to the world, even when language tries to hide it. Homebody's lengthy monologue introduces the reader to language's inadequacy, as she struggles to overcome words in an attempt to communicate.

3. The nonclassical aesthetic experience of uncertainty in world and language

Homebody's unique position in the play's structure is self-evident: her hour-long monologue opens the play and her unknown whereabouts fuels the remainder. Unlike the other characters, she ultimately synthesizes with uncertainty by fleeing to Kabul and becoming a series of paradoxical duals. Her flight marks the play's inciting action: she effectively disrupts the fragile status quo of her London abode—where anti-depressants, science and suicide are utilized to fight uncertainty—and forces her family to re-evaluate their "dry" luxurious existence by measuring Kabul's "wet" strangeness. Most importantly, the monologue introduces readers to uncertainty on the linguistic axis: the only axis the reader can access given the limited perspective. Early into her woeful tale, Homebody rails against the negative influence of classical science, proclaiming that:

> …magic beliefs are immensely strong, I think, only if their essential fragility is respected. It's a paradox. If such beliefs, magic beliefs, are untouched, they endure . . . and that is hard, for such is the expansive nature of these times that every animate and inanimate thing, corporeal or incorporeal, actual or ideational, real or imagined, every, every discrete unit of…of *being:* if a thing can be said to *be,* to *exist*, then such is the nature of these expansive times that this thing which is must suffer to be *touched* . . . All must be touched. All touch corrupts. All must be corrupted. (Kushner 10–11)

Speaking in metaphor, Homebody asserts that there "exists" incorporeal "things that are", and scientific measurement corrupts those things, drains them of their magic and renders them certain "fact": her opposition to Milton is evident. Curiously, her lamentation echoes Wheeler's delayed choice, an experiment designed by American theoretical physicist John Archibald Wheeler. Wheeler's experiment proves that photons act like waves when unobserved and act like particles when observed; an oscillating wave with probabilistic distribution seems to transform into a single actual particle upon measurement (9–48). Thus, Homebody vilifies the classicist urge to "reference and classify" (Minwalla 165–166) and supports a quantum worldview without supporting the scientific examination of the quantum world. These scientific analogues are aside from Homebody, however; she focuses on linguistic uncertainty and the "touch" of language.

Homebody asserts that language measures the world and thus drains it of its potential; in reaction, she speaks in uncertain and difficult language to preserve that potential. Voluptuous wordplay quickly clutters her monologue as she shrouds herself in arcane terminology ("Synchitic epexegeses" (14)), bewildering metaphors ("frequencies to the Universal Drift" (14)), or omits words entirely ("…in a crowded shop on _____" (17)).

In quantum terms, language is her measuring apparatus, and she avoids collapsing waveforms into particles by misaiming or otherwise abusing her tool. Simultaneously, her word choice renders her own magic untouchable: she cannot be understood, and thus cannot be reduced to a "thing that is". While preserving a mystical sense of self, Homebody's language alienates her family: Priscilla complains that "her weird forgotten words" made it "so she… demanded interpretation" (Kushner 65). Homebody's presentation forces subjectivized interpretation, which readers will constantly meet: they are forced to imagine where "_____" is and what "Universal Drift" means. In essence, the reader cannot decode the language Kushner gives Homebody. Denied essential semantic markers, Homebody is mired in the uncertainty she hopes to preserve. Her language continuously prompts the novum's semantic game, tempting the reader to verify the uncertainty of her language against the uncertainty of the world.

Homebody further complicates syntax and structure by speaking "elliptically… discursively": early in the monologue she confides that she is not capable of "syncresis—is that a word?—" and must speak with "synchisis, which is a word" (Kushner 2004, 12). Synchisis refers to a sentence whose arrangement obfuscates meaning, such as a garden path sentence or a sentence with abusive homophony. Syncresis, as recognized by Minwalla, appears to be a portmanteau of syncrisis, meaning a comparison of objects, and syncretic, reconciliation of opposing practices (162). Minwalla argues that the portmanteau "articulates a paradox": Homebody's statement means she has been pushed from (Western) paradox into (Third World) uncertainty (162). Considering Kushner's politics, the portmanteau of "syncresis" likely refers instead to the dialectical process: comparing and then integrating two objects. The impenetrable speech certainly exhibits the chaotic "synchisis" she claims; these linguistic gymnastics frustrate the reader's ability to grasp the meaning of her

longwinded diatribes, and Kushner's deft command of language keeps Homebody's personality largely uncertain despite an hour on stage. Few readers will recognize "syncrisis" or "synchisis" and thus will be unable to understand these terms as references. Homebody's linguistic games declare that dialectics—and its component cause and effect—has failed to bring her happiness and so she has turned towards purposefully "elliptical and discursive" thinking patterns.

Homebody asserts that her language reflects the true nature of the world she has come to know. Given that metaphor, omission, and misuse render her words uncertain, the untouched world is reconstructed to reflect these same properties. Homebody exposes the same uncertainty that surfaces when Milton struggles to define his career; linguistic uncertainty reflects the world's uncertainty. The reader is primed to accept uncertainty in language and also primed to accept language's relationship with the world: used precisely, it generates illicit non-nuanced identicals and used vaguely it captures the world but frustrates communication. *Kabul* then extends *Homebody*'s perchance for linguistic uncertainty into the fabric of the crumbling city. The doctor Qari Shah worries that his English is "impenetrable" because his terminology is steeped in medical terms (35), and characters speak Dari (43), Pashtun (44), Esperanto (47) German, and French (122).

The monologue represents an attempt to communicate with an anonymous non-responsive interlocutor, but her inability to stop "supersaturating [her] narrative with maddeningly infuriating or more probably irritating synchitic epexegeses" (Kushner 14) prevents this. Why does she want to communicate now, and what is the source of this linguistic failure? The similarities uniting Homebody's and Milton's miscommunication episodes expose an intriguing connection between Homebody and Milton, and by extension linguistic and scientific uncertainty. Milton fails to explain duals to Homebody's non-

nuanced identical, Mahala, suggesting that science does not resolve uncertainty but rather simply moves it from the world's "analogical space" into language. Milton himself admits that the unforgiving sciences "spits you out peremptorily" if you do not speak their language (120). This scientific language is shown as an obfuscating force that gives Milton a false sense of certainty. Homebody, who has "read too many books" (12), is similarly rendered unapproachable unless the reader is somehow familiar with her dense expert vocabulary, some of which is her own invention (12). The similarity is notably ironic: Homebody regularly identifies Milton as her opposite—he "gaseously effuses" whereas she simply "implod[es] and collaps[es]" (14)—and Kushner exploits their surface-level opposition to drive at an existential similarity. Both reflect the world's uncertainty in their language, intentionally or otherwise. The opposite fact is equally true—they both face an uncertain fictional world by forcing certainty on objects outside of their control. Milton asserts control over signals with time-frequency analysis, and Homebody asserts historical certainty over Kabul's chaotic history. Both the history book and Milton's mathematics, however, are products of language, and when the Homebody recognizes this similarity she flees.

Homebody's naïve understanding of Kabul captures her dynamic evolution and concretizes the play's uncertain work. Early into her monologue, she states that "exotic locales" hold the same magic as the unmeasured world; there, people believe that "some combination of piety, joy, ecstasy, industry" creates magic (10). She is happily ignorant of her prescriptive attitude; like Milton, she strips foreign cultures of their nuance by measuring them in fixed non-nuanced words. Her naivety is shattered when she buys Afghan kitsch: she hopes that the cultural strangeness will make her party guests "less certain of, of those *certainties* which … Because of which, for example, powerful antidepressants are consumed" (15). This journey is couched in her whimsical uncertainty to preserve the magic

of the place "where the shops are full of merchandise from exotic locales" she refers to the street as "_____" (10). In the shop, her hypocrisy is foregrounded: she notices that "three fingers on [the merchant's] right hand have been hacked off . . . a perfect clean diagonal from the middle . . . by, um, hatchet blade" (21). She realizes that the kitsch she came to buy is "shriveled . . . Third World junk" with "consumer appeal" (17) and this proof of personal violence shatters her conception of Kabul. Readopting the strategy she uses when reading the guidebook, she retreats into her imagination and tries to locate Kabul in space-time to recover a cause for this mutilated hand. The merchant's explanation "fractures the singular structure of cause and effect previously given" by Homebody's guidebook (Minwalla 169–170) by offering multi-world possibilities:

> I was with the Mujahideen and the Russians did this. I was with the Mujahideen, and an enemy faction of the Mujahideen did this. I was with the Russians . . . I did informer's work for Babrak Karmal . . . I stole bread for my starving family, I stole bread *from* a starving family, I profaned, betrayed, according to some stricture I erred and they chopped off the fingers of my hand. (23)

Just as a system's orbits go so arbitrarily close and arbitrarily far from one another, any of the possible causes the merchant tells diverge wildly while logically meeting at the same point—his flight from Afghanistan to London. The quantum structure emerges directly: he is waveform, every particle he could be suspended in equivalent actuality. Homebody is forced to recognize that she has been measuring Kabul through the guidebook just as Milton measures the quantum world through mathematics. The disfigured hand becomes the new image of Afghanistan—as Kushner epigraphs Nabi Misdaq "the shape of the map of present-day Afghanistan resembles a left-hand fist with an open thumb" (5)—and Kabul becomes a

horrific symbol of uncertainty, so war-torn that past is irrevocably tangled and future is unpredictable.

Milton accepts non-nuanced signals because the real signals are too microscopic to see and thus their uncertain nature is hidden by a perceptive barrier; Homebody similarly accepts a non-nuanced image of Kabul (past and present) because the real Kabul is too far to see and thus its uncertain and chaotic nature is hidden by distance. Both characters fill this distance with language—Milton's scientific language and Homebody's certain guidebook—and this language hides the world's uncertainty but does not remove it. Again, Kushner constructs *Homebody/Kabul*'s uncertain world by constructing its negation and then revealing the negation as false. Shocked, Homebody assuages her newfound guilt by correcting the issue of distance by traveling to Kabul. There, she recovers the principle of cause and effect for herself—by discovering the truth behind the man's hand—and shocks her family out of their certainties by integrating with Kabul as an uncertain being.

Homebody's linguistic struggles are ultimately mirrored in the structure of the play itself as a communicative object: discursive story-telling, many languages, and limited spatiotemporal scope similarly colludes to generate a world as uncertain as Homebody's language. *Homebody* effectively generates a map of the communication system the rest of the play navigates. Through Homebody's brush with Kabul, the reader witnesses a system exposed to the fullness of nuance and thus corrupted beyond sensibility. Previously, she coped with the uncertain world by regulating a certain image of Kabul—some distant paradise—but this image is grossly interrupted by a piece of non-nuanced, actual data: the merchant's hand and the violence it represents. Thus corrupted, she is compelled to fix the newfound uncertainty just as Milton does, by travelling to Kabul and measuring the system more precisely.

Ultimately, the reader is unaware of Homebody's fate: she either converted to Islam and married an Afghan or integrated with the ruined city through physical fragmentation and dissection. Through marriage, Homebody would repair the system through faith in "Allah's way" (35): as the doctor explains in Scene 1, chaos and war exist because Allah has so chosen. Such faith would repair the system, but follows Milton's path of entirely erasing nuance. Alternatively, fragmentation restores Kabul by allowing her to retrace its historical mixing through a similar obliteration. The authorities' medical account of her murder is the type of precise inventory she wishes Kabul had: "the left clavicle was traumatically separated . . . the infra spinous fossa quite, uh, shattered . . . separation and consequent calamitous exsanguination from the humeral stump . . ." (31). Kushner's clever construction only hints at the speculative structure through various characters' coping mechanisms, and as a result both of these solutions are allowed to exist simultaneously; a non-nuanced Homebody is going through each event because a woman goes through either situation every day in Kushner's Kabul. The nuanced Homebody is thus uncertain, quantum, and experiencing both.

Kushner morphs Kabul's destructive history, crumbling present and unknowable future into the perfect location for an uncertain fictional world. As Khwaja says, "'Afghanistan?' . . . would be more accurate, but such an accuracy as might discombobulate more than mere geography" (68). From the reader's limited perspective, Homebody's journey to Kabul does not repair Kabul's history or her own, and instead renders her as uncertain as Kabul. Every character similarly attempts to repair the world's uncertainty, but only find a solution that works for them: Milton's science does not work for Mahala or Priscilla, just as Homebody's Islam did not work for Mahala and Quango's heroin does not work for Milton. Any attempt to restore the positivist faith in a predictable future or cause

and effect is exposed as illusory. In the face of such bleak content, where is the optimism Kushner recognized?

Kushner's optimism emerges during the play's epilogue, which returns to London after the lengthy action in Kabul. As discussed above, Priscilla asserts that certainty is worth the cost of fascism and Mahala disagrees. Mahala states that any theory that offers "one idea for the whole world" is a lie, and only the "Dewey Decimal System" can make such a promise (138). It is a rare moment of levity, but unmistakably linked to Kushner's themes. Unlike Milton's system of classification that obliterates the original and leaves its "non-nuanced identical", the Dewey Decimal System only refers to the location of the original so the reader may themselves read it. Mahala's system sorts knowledge, but does not alter it or, more importantly, eliminate the nuance within the original packets of information (the books). Through Mahala, Kushner offers a postmodern solution to the supposed postmodern crises. In Mahala's world, many small theories reign and worldviews are instead dedicated to pointing towards each other in their entire nuance. *Homebody/Kabul*'s system is far more like the Dewey Decimal System than it is like Milton's totalizing approach: different characters index different theories and different coping mechanisms. The play's structure, characters and spatiotemporal arrangements point at a lingering existential uncertainty, but it does not offer a unifying approach to understanding, naming or overcoming this uncertainty. In the final lines of the play, Priscilla recognizes the value of this approach. Denying her previous assertions about her mother, she says:

> So she *left*. I miss her. I love her. She was my mother. But … Can I say this? In the space she's *left* … Some … *joy*? or something has been rising. Something unpronounceable inside is waking up. I … I have no word for this. (139, emphasis added)

Priscilla has adopted Milton's language—she now says her mother "*left*" instead of emphasizing the alive or dead contingency. However, Milton's phrase—"I am unmarried" (42, 102)—focuses on himself and obliterates Homebody entirely—"SHE IS DEAD!" (41).The difference is subtle, but the source of optimism. Milton's limited awareness shaves nuance and fits the world within a regular frame, transforming Homebody's disappearance into her death. While Priscilla similarly kills Homebody by switching to "she left" instead of "she is alive", her word choice lacks the totalizing pretense of "SHE IS DEAD". Her theory only asserts that her mother is dead within her subjective scope. The Freudian dimensions of Priscilla's resolution is evident—she must accept the loss of her mother to recognize the new mother in her place, which her father treats as essentially the same woman (Stevenson)—but such a reading does not explain or describe the construction of the world. Focusing on the linguistic transition, however, allows the resolution to climb from the structure of the fictional world and its novum: the events of the play show Priscilla (a constituent of the fictional world) that uncertainty is a physical fact of her world and, after confronting it, she adopts a coping mechanism as everyone else did. Her mechanism, however, recognizes the other strategies as valid, existent, and referable.

Conclusion

As mentioned above, Kushner likely found an uncertain worldview through the social philosophy of Walter Benjamin and not mathematics or science. Kushner is admittedly familiar with Benjamin's work, and considers Brecht's *Mutter Courage* to be the greatest play written in the twentieth century largely because it reflects Benjamin's view of history (Weber 119). Benjamin, a friend of Brecht and Heisenberg's contemporary, refuted social philosophy's faith in a recoverable cause and effect history by introducing concepts of

historical simultaneity and uncertainty. He argues that history is a radically fragmented image instead of a neat chain of events: harkening on Paul Klee's mono print *Angelus Novus,* Benjamin says history is something mankind looks back at as "one single catastrophe which keeps piling up wreckage" (257–258) while we are blown inevitably towards the future. Because it is only possible to reflect on what *has been* from the *here-and-now*, the two exist in simultaneous collage. It is impossible to access things the way they actually were, and history constantly flirts with obliteration: "the true picture of the past flits by" (255) as we are blown towards the future, and if it goes unnoticed, it becomes homogenized into history's wreckage. Benjamin's philosophy predates chaos theory, but the echoes are palatable: there are so many variables that cause and effect become mixed in one simultaneous collage image. The result is unpredictability, unrecoverability, and uncertainty. Even if Kushner saw *Homebody/Kabul* as a postmodern take on Benjamin—perhaps even a postmodern update to *Mutter Courage*—speculative fiction lenses have proven invaluable in analysing the play's world. As Stoppard proves in *Arcadia,* sometimes the stars align, and scientist, artist, and philosopher alike are willing to embrace chaos.

Homebody/Kabul reflects the irregular, anti-deterministic, nonclassical paradigm running through 20th century dramaturgy. It confronts the products of everyday conceptions of history—linearity and ontological certainty—and constructs a fictional world that fosters simultaneity and contradiction. By modelling uncertain dramatic relationships, Kushner continues a career-long trend of suggesting that classical modes of reasoning have regulated the world "at incredible cost to the human spirit, imprisoned as it has been in the delusion of strict determinism", while advocating the acceptance of strange and irregular "natural patterns" in their stead (Demastes 160). The world he constructs decouples possibility from probability, and ontological certainty from the state of affairs; yet it can be described in

entirely fictional terms by embracing terminology and concepts born from nonclassical scientific theories through the framework of speculative fiction analysis. This reading of *Homebody/Kabul* demonstrates that nonclassical approaches to contemporary fictional worlds are valuable methods, offering new insights into the structures and functions of such drama without pinning them to unintended rigidity. Borrowing nonclassical scientific theories additionally exposes a lush interdisciplinarity in nonclassical conceptions of the world: Benjaminian history, chaos theory, and fictional narratives all accept that possibility, probability, and necessity no longer order the world.

Conclusion

Quantum mechanics and chaos theory titillate the imagination and bring Romantic whimsy back into the popular worldview: the idea that aspects of the universe are in principle unknowable is a great source of inspiration. Bohr's theory of complementarity—that the type of measurement affects the observed result—is particularly invigorating to artists because it emphasizes the newly elevated role of the observer. By making a choice of what to measure, the observer chooses what is certain and what is not. Einstein found this fact metaphysically troubling: the new nonclassical theories suggested that "it's only through an initial, inexplicable act of quantum mechanical uncertainty that our universe came into being, setting off a chain of events that led to [us]" (Lindley 219). According to these new theories, Newton's world, filled with recoverable pasts and predictable futures, is a lie—a suggestion that Einstein was never willing to accept.

Like Einstein, the prevailing theoretical approaches to fictional worlds anticipate certainty and deterministic causality within a fictional world. These approaches do not expect the text to be a perfectly behaved atom, but they do expect the text to be a—possibly flawed, dynamically incomplete—reference to a world that functions according to deterministic machinery. This thesis demonstrates that this is often not the case: fictional worlds can be, just like the actual world, uncertain and chaotic. Many dramatists have accepted uncertainty and chaos and have borrowed them as dramaturgical structures. The three plays studied in this thesis do not fret the loss of the knowable universe, however: instead, they follow Bohr's lead and construct worlds wherein uncertainty or chaos reigns and the observers influence the things observed. These plays construct nonclassical fictional worlds that generate fictional experiences capable of grappling with post-quantum, post-chaos themes.

Most evidently, these nonclassical scientific ideas help describe previously elusive space and time arrangements found in contemporary dramatic fiction. Quantum mechanics forever changed scientific discussion about space because a particle can be in multiple locations, and chaos theory forever changed scientific discussion about time by disrupting the narrative of pattern and predictability. Drama is interested in quantum-seeming space and chaotic-seeming time. In her famous article "Visit to a Small Planet", the first two questions Elinor Fuchs asks about a play world is "what is space like on this planet?" and "how does time behave on this planet" (6). Her methodic approach should be taken to heart: the first thing the reader notices about a fictional world, especially in drama, is space and time. As this thesis shows, dramatic probability can no longer be measured like everyday probability because the nonclassical turn suggests that everyday rules fall apart at new scales of awareness. More than other genres, the material conditions of the theatre make it especially well-suited to interrogate nonclassical conceptions of space and time: the artist can tease performance time and the performance space. Focusing on the text, imprints of these manipulations are obvious. Bohr's concept of complementarity transitions gracefully to the discussion of plays, if only as a metaphor. If the playwright is analogous to the scientist, then their approach, style, and goals necessarily fix some dramatic objects as certain and others as uncertain. The studied plays show this approach.

Arcadia and *Possible Worlds* both elevate the reader's observational powers by emphasizing spatiotemporal relationships: each fixes one aspect of space and time in a regular flow to measure irregularities within the other. Where Bohr's scientist measures a variable, makes that variable certain, and places her interest on that variable, these dramatists do the opposite: the certain variable anchors the reader so they can explore the uncertain one, creating a framework to dramatically interrogate possible ramifications of uncertain space or

uncertain time. This playful inversion speaks to the different goals of the scientist and the artist when faced with strange discoveries: scientists aim to study one object in detail to uncover its secrets, where these artists are more interested in investigating uncertainty in and of itself. *Possible Worlds*' uncertain space inspires identity crisis and listless disorientation, and *Arcadia*'s uncertain time exposes today's trivial actions as the chaotic cause of tomorrow's major events. *Homebody/Kabul* happily embraces uncertainty on both axes, but to do so must strip the reader of their observational distance and limit her or him to a level of awareness congruent with the characters. It myopically shifts between certain space and uncertain space, classical time and chaotic time, to carefully construct a dramatic world wherein anything that is fixed is fixed through subjective choice alone. The world beneath is simply shifting sand, threatening to engulf the characters in chaos or ennui.

Each play furthers their investigations by directly commenting on the observer's role in shaping the observed. *Possible Worlds* suggests that the act of imagining something is equivalent to accessing it in some other world, and so the decision to measure is also a decision to create; *Arcadia* shows that people must decide how to interpret an object and force a narrative onto that object retrospectively, and show how trivial decisions can cascade and have a massive future impact; *Homebody/Kabul* explores the value of subjectivized, individual approaches to the world by showing different characters reacting to uncertainty in different ways. Instead of reading these plays as examples of metafiction, the richness of their aesthetic experience is better understood as a complex new fictional experience mediated by mechanisms similar to those found in speculative fiction. The gift of these plays is the myriad methods utilized to convince the reader to reconstruct a world that is not an everyday world, does not conform to Newton's laws, and is not powered by probability or necessity.

Finally, all three plays also involve a detective plot that never finds a satisfying conclusion; a commentary on the loss of recoverability and predictability caused by the nonclassical scientific shift. In *Possible Worlds,* the solution to George's murder satisfies the characters, but the reader's greater spatiotemporal awareness makes it obvious that the solution answers none of the questions introduced by the investigation. In *Arcadia,* Bernard employs great deductive reasoning and arrives at the wrong conclusion while Hannah successfully recovers the identity of the Sidley Hermit even though all of her evidence and reasoning is wrong. In *Homebody/Kabul,* Priscilla's investigation, which hopes to uncover her mother's fate, is thwarted by the titular city, and she closes the investigation by choosing to believe that the Homebody is dead to her. Through their spatiotemporal frames, *Possible Worlds* and *Arcadia* both suggest that there is an objective truth, but it falls outside of human capability to recover and so the characters fail; *Homebody/Kabul* takes a step further and suggests that there is no recoverable truth at all, and so the reader fails along with the characters. Put simply, *Possible Worlds* and *Arcadia* both hope that there is an order beneath the uncertainty and chaos, but it is an order that falls outside of humanity's epistemic grasp. *Homebody/Kabul* elevates the mystery to an alethic trait of its fictional world: there is no higher spatiotemporal awareness that would let the reader solve Homebody's murder. These two very different aesthetic experiences grow directly from the plays' nonclassical novum, and approaching the plays as speculative fiction highlights the construction of these unique aesthetic experiences.

Despite the occasionally dark subject matter in these plays, the turn towards uncertainty and chaos is not a bleak one. Instead, the case studies demonstrate that nonclassical fictional worlds structures can offer new aesthetic experiences for contemporary

readers in a post-quantum mechanics world. Mighton borrows the many-worlds interpretation of quantum mechanics to investigate the limits of imagination in an infinite-worlds understanding of reality, and Stoppard uses chaos theory to interrogate free will and agency in a seemingly random world. Kushner, who likely found uncertainty through entirely non-scientific routes, nonetheless toys with uncertainty to argue for the value of subjectivized small theories over giant sweeping ones. More than postmodern, I would argue that these themes are nonclassical—they directly confront classical assumptions of space, time, and being implied by Newtonian, positivist, or dialectical paradigms. Contemporary artists, playwrights in particular, seem equally interested in a nonclassical world.

This thesis approached each case study by locating a novum unique to each text. This process illuminates these fictional worlds on a case-by-case basis, but it also points towards the necessary next step in this research: the development of a fictional worlds framework that is flexible enough to discuss nonclassical fictional worlds that don't necessarily have an identifiable novum. The theory of the novum explains how a text can substitute logical expectations with alogical ones, but it leaves a major question: do other fictional worlds operate around logical expectations, or is this a faulty assumption? Amongst natural philosophers and scientists the post-quantum mechanics world is notoriously unintuitive and seemingly alogical. These ideas are influencing how artists view the world and the worlds they construct, and the analytical frameworks used to discuss fictional worlds need to follow suit. If the real world cannot be described as certain states of affairs, why should we assume fictional worlds can be described with certainty? Some narratologists, such as David Herman, are investigating a cognitive theory of mind capable of accounting for imagination's role in the process of world-constructing (*Story Logic*). Such an approach aims to describe how imagination may or may not assume that a fictional world is a logical interpretive

model. More pressing to theatre studies, there needs to be deeper investigation into the mechanisms that construct nonclassical fictional worlds on stage in the performance context.

Examining a performance text instead of a written dramatic text opens up a new array of theoretical considerations untouched in this thesis. Foremost is the materiality of sign on stage, compared to the conceptual nature of the dramatic text's written words. Theatre's greatest semiotic quirk is the proximity between the real object on stage and the fictional object it represents. The stereotypical example is the chair on stage: it is both an object with a function and a sign for a fictional chair in the fictional world of the action. When examining the fictional world generated by a written text, the conceptual nature of the signs has an intuitive advantage: pragmatically, it's easier to write "the coin flips and lands on heads and tails simultaneously" than it is to show the same situation on stage directly. According to Thomas Martin's concept of semantic relativism, literature is able to create fictional statements in lieu of factual ones because it establishes a pragmatic context where things can be read as provisionally true (117). The context of the sign leads the reader to accept the dramatic action as fictional instead of metafictional. The same concept extends easily to the performance context: the context of the stage convinces the spectator to accept the space, the actions of the characters, and the statements of the characters as provisionally true within the context of the performance. The study of nonclassical fictional worlds on stage requires an examination of the mechanisms that convince the spectator to accept certain stage elements as conceptual indications of nonclassical ideas instead of iconic indications of something more proximate to their material reality. The expansion into performance texts will also require a deeper appreciation of theories of perception: how the spectator perceives space and time within the theatrical event, and how these senses can be tricked. Observable stage space is, by its nature, certain, but spatial illusions allow artists to create the sensation

of uncertainty just as Mighton creates spatial uncertainty through quickly shifting scenes in *Possible Worlds.*

Finally, it is important to highlight that there is no hierarchical path through which discoveries flow from scientists to social philosophers and artists. When Heisenberg stepped away from the positivism of Newton's perfect world, contemporaneous philosophers independently came to similar conclusions about reality's uncertainty. Walter Benjamin's theory of history would seem indebted to chaos theory if not for their chronology. Artists also examined ideas startlingly close to chaos theory before mathematicians formalized the concept. In 1952, an entire decade before Lorenz's pioneering work on chaos theory, Ray Bradbury's short speculative fiction story "A Sound of Thunder" told the story of a time-travelling hunter who changes the future by accidentally killing a butterfly in the time of the dinosaurs. Bradbury's butterfly effect reminds us that there is no predictable linear relationship between natural theories and ideas. Perhaps Bradbury's story highlights the greatest power of speculative fiction: when an artist freely substitutes world logics that are alternative to the everyday, they can freely construct the very same worlds that scientists, natural philosophers, and mathematicians are theorizing.

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